MAR 16 1921

Vol. LXXXVIII. No. 2257. [All Rights Reserved.] FEBRUARY 25, 1921. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage.] PRICE SIXPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 6d.; Canada, £1 12s. 6d.; Colonial and Foreign, £1 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, Ltd., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque. Telegraphic Address: "Ageokay, Cent., London." A B C Code. Telephone Nos. City 997; Central 4425 (Editorial only).

LITHOLITE INSULATORS, Ltd.
55—57, Hackney Grove, London, E. 8.
Phone and Telegrams: Dalston, 592, London.
FIREPROOF AND OTHER GRADES.
ESTABLISHED NEARLY 30 YEARS.

Birkby's **"ELO"**
For all purposes for which moulded insulation is required specify "ELO"—which is water, oil and fireproof.
FLEMING, BIRKBY & GOODALL, LTD., LIVERSEDGE, YORKSHIRE.

WRIGHT 'Phone: 499 Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

EVERY DESCRIPTION OF
SMALL TURNED PARTS and CASTINGS for ELECTRICAL ENGINEERS.
A. MORTON,
6, Tenby Street North, Birmingham.

BROOK
ONE, TWO and THREE-PHASE
MOTORS.
See Sup. 70.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors,
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA & MICANITE
TAYLOR & PETTERS, LTD.,
40, Hatton Garden, London, E.C. 1.
'Phone: 4575 Central. See Page ii.

MOTORS. • DYNAMOS.
VICTORIA DYNAMO & MOTOR CO.,
CRAVEN HOUSE,
Kingsway, London, W.C. 2.
Phone: Gerrard 1248.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

SKATOSKALO BOILER SCALING TOOLS.
Sole Maker:
FRANK GILMAN,
9, Westfield Road, BIRMINGHAM.
See Advertisement this week, Sup. 15.

"EMPIRE"
AUTOMATIC CONTROL
FOR
Pumps, Compressors, Machine Tools.
ELECTRIC CONTROL, LIMITED, GLASGOW.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C. 2
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement last week, p. xxxii.

CONNOLLY'S (BLACKLEY), Ltd.
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST.,
CLERKENWELL, LONDON, E.C. 1.
Wire Voltograph, London. 'Phone: City, 8060.

ELECTRIC MOTORS.
One, Two and Three-Phase.
BRITTAIN'S ELECTRIC MOTOR Co.
(Late Langdon-Davies Electric Motor Co.),
110, Cannon Street, London, E.C. 4.

INSULATING -- BEADS --
Immediate Delivery.
HOLDER-HARRIDEN LTD., 35/37, Noble St., London, E.C.

THE LOWEST TENDER.
See page xiii.

Better than Rubber, Leather and Gutta-Percha.
BELTING.
DERMATINE
DERMATINE CO., Ltd.,
Neate St., London, S.E. 5

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
REPAIRS TO ANY MAKE **MOTOR STARTERS.**
THE SOLENOID REGULATOR CO.,
HIGGATE SQUARE, CAMP HILL,
Telephone: Midland 400. BIRMINGHAM. Telegrams: "Solenoid, Birmingham."

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

ELECTRIC MOTOR REPAIRS.
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON, S.E. 1

RAYNER & HEALD, LTD.,
DUKE STREET, DERBY.
TWO & THREE-PHASE MOTORS only.

FULLER'S UNITED ELECTRIC WORKS, LIMITED,
MANUFACTURERS OF
ACCUMULATORS BATTERIES
WIRES & CABLES CARBONS, &c.
WORKS: SHADWELL HEATH, ESSEX.
General Sales Offices:
IDDESLEIGH HOUSE, Caxton St., Westminster.
Grams: Electrical Fitz London. Phone: Victoria 4337.

INGLEBY & Co.,
ELLAND ROAD, LTD.
MOTORS LEEDS.
FOR DIRECT AND ALTERNATING CURRENT Tel. 373.
Delivery from Stock up to 50 H.P.

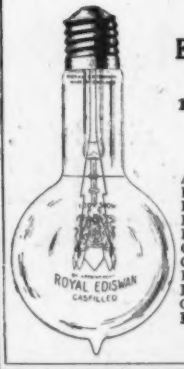
Advertisement Index, see page xl.

ROYAL EDISWAN

Gasfilled & Vacuum Lamps.

REDUCTION IN PRICES

IF you have not already received a copy of our Schedule showing the Reduced Prices, write to our nearest Depot.



THE
Edison Swan Electric Co., Ltd.,
Ponder's End, Middlesex.
123-5, Queen Victoria St., E.C.4
AND
71, Victoria Street, S.W. 1.

BRANCHES:—

ABERDEEN.	LEEDS.
BELFAST.	LIVERPOOL.
BIRMINGHAM.	LEICESTER.
BRIGHTON.	MANCHESTER.
BRISTOL.	MIDDLESBROUGH.
CARDIFF.	NEWCASTLE.
CORK	NOTTINGHAM.
DUBLIN.	SHEFFIELD.
DUNDEE.	SOUTHAMPTON.
GLASGOW.	SWANSEA.
HULL.	

AUSTRALIA: MELBOURNE, SYDNEY and BRISBANE.

"SAFETY FIRST"

IS A GOOD MOTTO,

BUT

"SAFETY ALWAYS"

IS A BETTER.

DEVELOP THE

"CANTIE" HABIT

AND ENSURE

"SAFETY ALWAYS."

AIRBREAK IRONCLAD SWITCHGEAR

for all purposes.

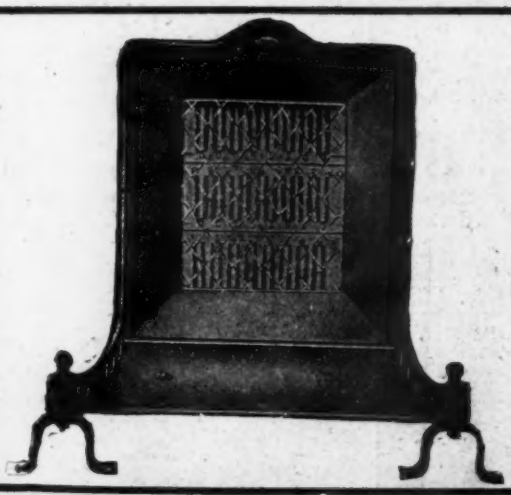
CANTIE SWITCH CO., LTD.,
Leighton Street, **NOTTINGHAM.**

MICA & MICANITE

INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
Contractors for Air Board, War Office and Admiralty Requirements.
CUTTING AND GAUGING OUR SPECIALITY.
BEST QUALITY MICA ONLY.

'PHONE—4575 CENTRAL.
TELEGRAMS—"MICAYLOR, LONDON."

TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C.1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.



THE

ARORA ELECTRIC FIRE

Has given universal satisfaction.

WHY? Because OUR patented Element is of HEAVY SECTION and has LOW Current Density, yet it GLOWS at a HIGH TEMPERATURE.

Low Price, Robust, Cheery, Economical.

Write for List E (Fires & Cookers) to Sole Manufacturers:

THE ARORA CO., Loughborough.
(Proprietors: Mansuetus & Co., Ltd.)

Telephone: CITY 3115. Telegrams: VANDUARA CENT LONDON.

Contractors to H.M. Government.

ELECTRICAL INSULATING **TAPES, WEBS, CORDS, SLEEVING, &c.**

DELIVERY FROM STOCK.

JOHN MACLENNAN & CO.,
115, NEWGATE STREET, LONDON, E.C. 1, AND AT 186, INGRAM STREET, GLASGOW.

THE

ELECTRICAL REVIEW.

VOL. LXXXVIII. FEBRUARY 25, 1921. No. 2,257.

ELECTRICAL REVIEW.

Vol. LXXXVIII.] CONTENTS: February 25, 1921. [No. 2,257.

	Page
Costs—Capital and Labour	225
Industrial Reorganisation in Individual Works	226
The Paris Lighting Concession	226
It's All Wrong!	227
The Telephone "Ramp"	227
The Chester Inquiry	227
The New Sessions House, London County Council (*illus.*)	228
The British Industries Fair	239
The Efficiency Exhibition (*concluded*)	232
Joint Electricity Authorities	233
Correspondence—	
The Reduction in Price of Lamps	236
Wiring in Ferro-Concrete Factories	236
Shop Displays	236
Charging Batteries for Motor Cars	237
A Question of Ethics	237
A Flashing Problem	237
Legal	237
Business Notes	238
Notes	245
City Notes	248
Stocks and Shares	249
Market Quotations	250
The Brown-Boveri Mercury Arc Rectifier for Large Outputs, by R. L. Morrison (*illus.*) (*concluded*)	251
The Severn Barrage Scheme (*illus.*)	254
New Electrical Devices, Fittings and Plant (*illus.*)	257
Stability of Contracts	259
A Glasgow Turbo-Alternating Breakdown	259
New Patents Applied for, 1921	260
Abstracts of Published Specifications	260
Contractors' Column	Advertisement page xxviii

"ELECTRICAL REVIEW" SUBSCRIPTION RATES.

UNITED KINGDOM	£1 14 8 per annum.
CANADA	1 12 6 do.
COLONIAL and FOREIGN	2 1 8 do.

Postage Free.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 6d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGREKAY, CENT., LONDON." Code, A B C.
Telephone Nos.: City 997 Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c. Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TOKYO: Maruzen Co., Ltd., 11-16, Nihonbashi-Tori-Sanchome.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed, "London City and Midland Bank, Newgate Street Branch."

COSTS—CAPITAL AND LABOUR.

DURING the past few years an increasing amount of attention has been given to the question of costing in engineering works. It may not seem a very profound remark to suggest that this is an important matter, yet it is an astonishing fact that many firms have not regarded it altogether in that way. Too often was the costing department, so-called, left to the tender mercies of a clerk, whose sole qualification for the post was that he was good at figures. The circumstances of the past six years have opened our eyes to our shortcomings in this respect, and the establishment a few years ago of the Institute of Cost and Works Accountants was an important step in the direction of creating a new branch of skilled persons known as works accountants, whose function is a quite separate one from that of the accountant who comes in once or twice a year and audits the books.

The works accountant, as a moment's reflection will suggest, should come next in importance to the managing director and the works manager, and should be in daily consultation with them. Only in that way can the management keep a check on its costs, and endeavour to hold its own with its competitors. It is necessary at the same time that the works accountant should have a thorough training in costing accountancy, and one of the first steps taken by the Institute of Cost and Works Accountants was to institute an examination scheme. Thus membership of the Institute can be relied upon by employers as signifying that such a man applying for a post has at least some qualification.

Such detailed attention has been given to costing generally now that a stage has been reached when the question of standardisation of systems of costing is being seriously discussed. As a matter of fact, in the printing trade, a standard system has been evolved which, it is said, can be adapted to a firm employing 2,000 workmen, or to one employing 20 workmen. However that may be, it is highly probable that greater difficulty would be experienced in the engineering trades, although there does not seem to be any reason why standardised methods should not be worked out for special branches. The accurate allocation of overhead charges seems to be the main difficulty, and here, of course, the particular conditions in the firm, including the up-to-dateness of the equipment or otherwise, have an important bearing. For ordinary rough works purposes, it is perhaps accurate enough to cost with a flat percentage for overhead charges, but it must, of course, be elaborated when questions of improved methods of working are under consideration. Indeed, the possible ramifications of a costing system become greater and greater the more they are considered, but a word of caution is necessary against over-elaboration, because a point can be reached when the cost of a costing system will outweigh the supposed advantages. Nevertheless, in a works of any magnitude, some detail is necessary, but the amount depends upon circumstances, and this brings out the importance of common sense on the part of the works accountant. Thus it is apparent that the cost accountant should be not a mere supervisor of clerks, but a man of initiative, who can place before his employers figures

and logic which, among other things, have a direct bearing on the relations between the employer and the workmen.

Indeed, this aspect of the importance of costing is by no means its least. A case in point is that in which a firm found itself undercut by a competitor. The piece-work rates were reduced as the result of a close investigation of the costs, and in order to convince the workers of the facts, not only were the firm's own costs placed before the workers, but also invoices for similar goods actually bought from other makers at lower prices. The result was that the reduction in piece rates was agreed to.

It will thus be seen how a competent cost accountant is really the pivot of the whole scheme of management, although it is not at all certain even now that when he can show the works manager he is wrong, his advice is always taken. Then there is the question of the relations between the costing and selling departments, which must be of the closest possible character. In many of our large engineering works, of course, the significance of all these matters is recognised, but there are far too many instances where old-fashioned methods are still in vogue. These are having the effect not only of causing prices to remain high in some instances, because with a judicious rearrangement of costing the price could perhaps be lowered, but also this policy may easily, and in fact has been known to, act in the opposite direction. Particular items have been sold actually at a loss, and the fact has only been found out when an accurate costing system has been introduced.

A discussion of this aspect of works management serves to throw a special light upon the real importance of the administrative staffs, which has been rather overshadowed in the many controversies between what is called capital and labour. The fact is that the administrative staff is a vital link between the employers and the wage-earning staff, yet it has been seriously neglected in the consideration given to it under the changed conditions of the present time. How essential is the administrative staff was well shown when the Italian workmen, who seized the engineering works last year, found themselves helpless because the technical and administrative staffs did not fall into line with them. This all goes to prove that the psychology of industry is not merely an adjustment of the differences between employers and the rank and file of the workmen, because both would, so to speak, be lost without the connecting link formed by the administrative staff.

Industrial Reorganisation in Individual Works.

The necessity for new methods to meet our present new industrial era is admitted on all sides, and chief amongst these is the question of increasing co-operation between labour and capital. The precise problem for most industries is to get some effective machinery inside individual works to attain this end.

We have received a very interesting communication from the Commonwealth Edison Co. which bears on this subject. It appears that this company is solving the problem by establishing an "Industrial Relations Department," with a duly appointed manager at the head of affairs. This department is charged with everything which deals with the well-being of the employés, and especially with the harmonious relations between employés and the management. One of the first matters which this department has taken in hand is the "employés' representation plan." This "plan" is practically an analogue of a Works Committee, being composed of two sides, one representative of the employés, and the other of the employers. The fact that the president of the Edison Co., Mr. Samuel Insull, is adopting an industrial method of this kind for his own company should carry with it a very strong recommendation for the establishment of works committees in the electricity supply industry in this country. Up to the present, works committees are the only part of the Whitley scheme not yet adopted, but the National Council is dealing with this matter at the present moment, and it is hoped that it will shortly issue very strong recommendations that works committees should be set up in all the undertakings in the country.

In this connection it is interesting to note the very strong recommendation which Sir Lynden Macassey expressed in his recent address on "Present-Day Industrial Psychology." He contended that it was vital for the future of industry to recreate the interest of the individual workman in his work, an interest which had languished due to mass production; that the only remedy for this decay of interest was for capital to ensure that both the administrative staff and the wages staff could acquire a wider interest in the prosperity of the works in which they were employed and of the industry of which the works formed part; that works councils, provided they had adequate powers, were infallible means to the creation of such a stimulus. The foregoing is, of course, only one of the many identical recommendations from leaders in industry on the employers' side (among the most sagacious of whom there seems to be a unanimous opinion) as to the pressing need for the universal establishment of works committees.

The Paris Lighting Concession.

As we recently mentioned, a new agreement is to be entered into between the Paris Municipal Council and the Compagnie Parisienne de Distribution d'Electricité, modifying the terms of the convention which was concluded between the two parties on September 5th, 1907, concerning the supply of electricity in Paris. According to the latter, the company's concession would expire on June 30th, 1940, but it is now proposed to extend it for five years to the end of June, 1945. It appears from a report presented to the Municipal Council that the Council was compelled to sanction an increase in the selling prices for electricity last May, the receipts from the higher charges having been carried to a special account for future settlement. The proposed new agreement will regulate four main problems and all secondary questions which in practice have shown the defects of the convention of 1907. In the first place, the fixed tariff is to be replaced by a variable tariff which, taking into account ministerial orders, applies an economic index according to the variations in the price of coal and in the rates of wages. Secondly, the question of the *personnel* has been settled by placing entirely at the charge of the company the responsibility for the payment of the officials, staff, and workmen of all classes. In the third place, the cost of supplementary works is to be defrayed with the aid of a special fund fed by a levy on the gross proceeds of the sales, and the concession rental payable to the City of Paris has been materially increased. It is further provided that for complementary works of first establishment, temporary treasury advances, redeemable by the City, can be made by the company by means of short-term loans or banking credits, the conditions of which will require the approval of the City.

The agreement further states that the company has undertaken to discontinue the legal proceedings in progress having reference to claims raised either from the fact of the economic circumstances resulting from the war or with regard to the difficulties in interpreting the original convention. On its part the City of Paris has undertaken to abandon the legal action relating to the execution of complementary works, and renounces the recovery from the company of the credits voted by the Municipal Council prior to the signature of the new agreement, and the company also renounces the recovery of the sums expended by it previously in excess of the 1,700,000 fr. annually fixed for new works. It is suggested that under the new agreement the company's dividend will increase in proportion as the cost of producing electricity declines, that is to say, in proportion as the coal and wages indices fall, which regulate the cost price and consequently the selling price of energy.

It's All Wrong!

We are daily—and oftener—told that half a million admirals and generals and people of every sort have studied Pelmanism, and we understand that this study is based upon a knowledge of some of the laws and principles of psychology. Moreover, there are books galore on the subject, and professors and exponents of the science can be met, like the party leaders under King Goodheart's regime in the song in "The Gondoliers," in twos and threes in every street. May it not, then, be confidently assumed that some of those concerned in the administration of London's traffic have some nodding acquaintance with it?

Whether that be so or not, we see few signs of an intelligent understanding of the British temperament in some of the methods adopted in the desperate hope that they will accomplish results that can only be produced by adequate service. Notices telling the passenger to "keep to the left" at one station, and neutralised by peremptory injunctions to "keep to the right" in another, are not conducive to efficiency. Bawling youths, calling upon passengers to "pass down" a car already rammed full to the roof, produce nothing save soreness of their own throats. The "Stentorphone" at Oxford Circus would tempt a medieval warrior to get to work on it with a battleaxe. The new pattern of railway coach recently described in our columns is a considerable improvement, but all that we have seen have been for first-class service, whereas the remedy is more urgently needed by the third-class passengers.

Turning from the Underground, we find that conditions on the suburban lines during the rush hours are indescribably bad. The slightest fog, and everything is disorganised completely. Goods trains lumber slowly through stations upon the platforms of which the crowd steadily increases. When the long-expected suburban train arrives, a hydraulic press is needed to get any more passengers into it. The ensuing struggle at the doors is entirely vain.

Then the omnibuses seem careful to avoid stopping at the right places, so that if there is any semblance of a queue—which isn't often—it rapidly dissolves into a scrambling, trotting mass, and those who have waited longest, or prefer not to struggle, may go on waiting. The Paris system of numbered tickets works well, and passengers would soon get accustomed to it.

The average passenger is a peaceable individual, only anxious to proceed on his or her journey, causing, and being caused, the minimum of trouble. Pushing, and bawling (human or mechanical), and uncodified directions, and lifts in which the first enterer is the last to leave, and ill-considered expedients of every sort, are irritating and ridiculous, and we believe that it would be possible to do better without them.

The Telephone "Ramp."

By persistent and vociferous agitation, culminating in a debate in the House of Commons, the opponents of the Postmaster-General have gained their immediate end—the appointment of a Select Committee of Inquiry into the administration and conduct of the telephone service. Whether they will achieve their ultimate object—the withdrawal or modification of the new tariff, and the retention of the flat rate—is open to question; the new rates are to come into force on the appointed day, and apparently no reimbursement of payments is contemplated by the Government, in the event of an adverse report. Chopping and changing is fatal to the efficient conduct of any business, and we do not wonder at the reluctance of the Government to give any pledge in that sense.

That the report of the Select Committee will in the main bear out that of the committee which has already endorsed the Postmaster-General's proposals we have no doubt; facts are stubborn things, and that the continuance of the flat rate simply means that the big flat-rate subscribers will be generously subsidised by the smaller users—assisted by the ordinary taxpayer—is certain, unless the rental is put up to £30 or £40, an unlikely event. Much has been said with regard to the inefficiency of the service, and much of it is justified; but what would you? It was well known to those who understood the matter that inefficiency would be the inevitable result of nationalisation. The only gleam of hope—and it is a faint one—is the possibility that the Committee will recommend the removal of the service from the control of the Post Office. But that, we fear, is a Utopian idea.

The N. Wales & Chester Inquiry.

The protracted inquiry into the schemes proposed for the North Wales and Chester District which the Electricity Commissioners have been holding at Llandudno affords further evidence of the regrettable absence of the co-operative spirit which is essential to the success of the proposed authorities. As in the case of the Liverpool inquiry, the representatives of many of the local authorities concerned were openly out to crab the scheme; it was noteworthy that the majority of the authorities, like the Chester Corporation itself, relied upon their own permanent officials rather than upon counsel, and apparently this practice is not conducive to geniality and goodwill. The Connah's Quay U.D.C. had already described the Chester scheme as "repulsive," and Rhyl expressed a desire to cultivate its own allotment in its own way.

The case for setting up a Joint Electricity Authority, and for the scheme of the Chester Corporation in which it is embodied, was very ably presented by Mr. J. H. Dickson, the town clerk, who was complimented by the chairman on his performance. As the acoustic properties of the Town Hall are far from perfect, and caused much inconvenience to all parties, all the more credit is due to him for his achievement. His task was not facilitated by the introduction of amendments to the scheme at the last moment, with a view to meeting various objections.

Both the Chester Corporation scheme and that of the North Wales Power Co. have been outlined in our pages. Summarised, the former proposes a Joint Electricity Authority for the whole area, based on a system of representation calculated on the rateable values of areas and the capital expenditure of authorised distributors. The engineering scheme consists in leaving the North Wales Power Co. to develop the North-Western area, in the development of a series of low-fall water-power stations on the river Dee, about 20 miles above Chester, coupled together on the Thury system, and in building a steam station on the lower Dee, to act as a stand-by and supplementary plant. It is proposed to deal in the early years with an extension into the salt area of Mid-Cheshire, and later to couple up via the North Wales coast route with the North Wales Power Company. At the outset, pending the completion of works, a bulk supply has been arranged for, from the Government factory at Queen's Ferry.

The constitution of the Joint Authority bristles with points which may cause lively opposition, but it must be said that the scheme appears to be well thought out, and is the result of numerous conferences with interested authorities. It is, we believe, in great part the work of Mr. S. E. Britton, electrical engineer to Chester Corporation, who for years past has minutely studied the subject and investigated the resources and requirements of the area. The success of his hydro-electric plant on the Dee is well known to our readers. We must not, however, detract from the credit due to Mr. E. N. Humphreys, the first witness, who was until recently chairman of the Chester Electricity Committee, and who has been largely responsible for the scheme. His examination-in-chief showed him to be a thorough master of every detail of the subject, and it must be said that he deserves and has the gratitude of all those who support the scheme.

At the time of writing the inquiry is still in progress. We commence a report of the proceedings elsewhere in this issue.

D

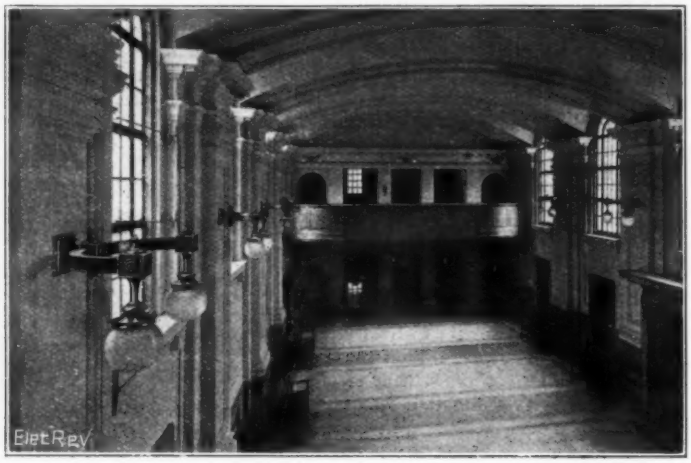
THE NEW SESSIONS HOUSE, LONDON COUNTY COUNCIL.

Early this year the new Sessions House, which has been built by the London County Council in Newington Causeway, London, S.E., was completed and brought into occupation. This fine building, which provides for the accommodation of the Metropolitan Courts engaged upon the trial of civil cases, and is therefore on a par with the Central Criminal Courts in the Old Bailey, was commenced in 1912, and had been carried a long way towards completion when the outbreak of war necessitated the suspension of building operations; it is of very substantial construction, and its internal finish and equipment will compare favourably with those of any other courthouse in the country. The building consists of three floors and a basement, and covers an area of some 43,500 sq. ft.; on the ground floor there are three courts and a public hall, and ample accommodation is provided for the Bench and the Bar, officials, police, domestics, the general public, and, of course, the prisoners.

For a public building of so much importance, it was desirable that the lighting, lifts, heating, and ventilating arrangements should be of the first order, and a recent inspection of the equipment has satisfied us that nothing has been left undone to secure this end. The work has been carried out to the specifications of the engineer to the London County Council, Mr. G. W. Humphreys, M.Inst.C.E., the electrical engineer to the Council, Mr. C. A. Baker, M.I.E.E., and his assistant, Mr. H. M. Harding, being responsible for the design of the whole installation and supervising the work.

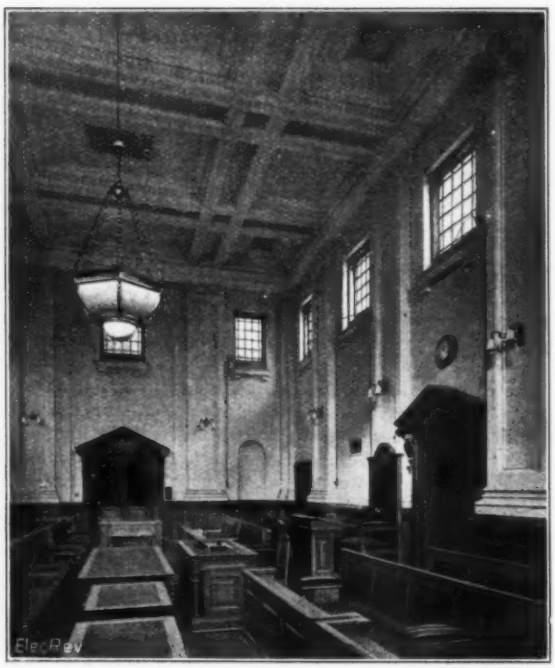
The principle followed by Mr. Baker in preparing the lighting scheme was generally that of semi-direct illumination, supplemented by a certain proportion of direct lighting; he is not, however, a slave to any particular system, but uses whatever device he regards as most appropriate for the purpose in view. The contractors for the lighting equipment were the Alpha Manufacturing Co. Electricity is supplied from two

Photo by] [*London News Agency.*



The Public Hall.

Simplex Foot-warmers.



Views of the Courts, showing the Electric Lighting Fittings and Clocks.

sources: The London Electric Supply Corporation, a.c. at 220 volts, 85 cycles; and the Metropolitan Borough of Southwark, d.c., 3-wire, at 220 and 440 volts. The a.c. supply is the main source for the lighting system, and the d.c. for the pilot circuits and for a stand-by to the a.c. supply, as well as for all the motors and heating appliances. The meters and main switchboards are installed in a room in the basement, and there are 28 lighting and seven power distribution boards in the building; the distribution boards are let in flush with the wall surface, and provided with wooden doors matching the surrounding decorations. Most of the wiring is protected with screwed steel conduit, into which the cables were drawn after the pipe-work had been finished; no joints were allowed, looping-in being generally adopted, with connector boxes where this was not practicable. At certain points surface wiring with flexible cords carried in insulated eyelets is employed, and in the corridors on the ground floor, and in some other situations, metal-sheathed twin conductors are used. Draw-in boxes under parquet floors are fixed flush with the floor level, the covers being filled with the material used for the surrounding floor; in plaster work they are encased in wood with a polished wood flush cover. The covers of switches in the Courts and other principal rooms are of bronze.

The public hall is exceptionally well lighted, with 100-watt gasfilled lamps in globes, which are carried by eight handsome bronze bracket fittings, each supporting two globes; in addition a number of smaller lamps are provided for local illumination. The Courts are lighted by large ornamental pendant bronze bowl fittings, which are suspended under the domed roofs from winches; there are two circuits in each fitting, and the connections are made with four concentric rings, the raising gear being that supplied by the London Electric Co., which takes the strain off the hoisting rope when the fitting is in place. Courts Nos. 1 and 2 each have one of these fittings, containing one 1,000-watt and three 500-watt gasfilled lamps; Court No. 3 is provided with a similar fitting containing lamps of smaller candle-power. The glass bowls used for these fittings were specially chosen and tested, permitting the transmission of about 45 per cent. of the light, the remainder being reflected on the ceiling. In each Court additional local lighting is provided by wall brackets carrying vacuum tungsten lamps in globes. An excellent effect is produced, the light being agreeably mellow, but amply sufficient for all purposes. Illumination tests show that in the courts there is an intensity of 3.8 to 4.2 foot-candles, and in the public hall 4.0 to 5.1; in the Deputy Chairman's room, the Justices' common room, and the Bar mess, the illumination is between 3.1 and 4.0 foot-candles, and in the Standing Joint Committee room it is 5.7. These results justify the accuracy of the formulæ on which Mr. Baker calculated the whole of the illumination figures in designing the installation. The prison cells, at a height of 3 ft., receive 0.89 foot-candle. The Committee room, which is a very handsome apartment, is lighted with two bowl fittings, each containing three 300-watt lamps, together with wall brackets; the Justices' common room is provided with three fittings each containing three 150-watt lamps, and eight 60-watt metallic filament lamps in two-light brackets.

Bowl Fitting for Committee Rooms (Strode and Co.).

In the corridors flat fittings are fixed to the ceilings, and fed from special circuits, a certain proportion of the lighting supply being derived from each of the two sources. In the Records Store Room portable lamps with connections to wall plugs are provided. Special attention has been given to the lighting of the staircases, the fittings being so disposed that the lighting is approximately uniform at all points; holophane globes are used, centrally suspended.

The fittings suspended in the Courts, which weigh about 1½ cwt. each, were made by Messrs. Simplex Conduits, Ltd., who also supplied the large brackets for the Public Hall and the brackets in the Courts, and 60-watt foot-warmers for the use of the judges, magistrates, and clerks in the Courts; the bronze fittings in the committee rooms, jury rooms, vestibule, and corridors were made by Messrs. Strode & Co., Ltd.—all to designs approved by the County Council.

The building is provided with a hot-water central heating system, with Verity 5-h.p. duplicate motor circulating pumps. Special attention has been given to the ventilating system, which was carried out by the Buffalo Forge Co., Ltd. Two main ventilating installations, electrically driven, have been put down in the basement, in which the air is washed and filtered, and warmed by steam if necessary; the air is distributed by large steel trunks, of excellent workmanship, and is also removed by exhaust fans, a combined plenum and vacuum system being adopted. The kitchen being equipped with gas cooking apparatus, special fans have been installed to remove the fumes, by the Keith & Blackman Co., with Veritys' motors. The motor starters were made by Messrs. Brook, Hirst & Co.

The ninety prison cells in the basement are provided with separate ventilating equipment, and with electric bells. The pushes for the latter, which were made by the Alpha Manufacturing Co., are fixed near the doors, and fitted with mechanical indicators; when a push is pressed, an electric indicator informs the warder in which block it is situated, and an arm falls to a horizontal position at the door of the cell, so that the warder, looking down the corridor, can see at once where the call has been made.

There are two Waygood-Otis electric passenger lifts, one for the use of the public, and one for the justices. Each of these lifts is arranged to take a load of seven persons, at a speed of 200 ft. per minute, and is fitted with a worm gearing and sheave drive, fixed overhead, and driven by a motor specially designed for lift service, rated at 10 h.p. The makers' standard electrical controller is provided, giving smooth and gradual starting and stopping, and operated by a switch in the car with a self-centring handle. The cars are of English oak, and are fitted with safety gear which is operated by a special governor, designed to come into operation in the event of the car attaining an excessive speed on the downward journey from any reason. The guides for the car and counterbalance weight are of round turned steel. Patent electrical and mechanical locking gear is fitted to the landing gates, designed to prevent the lift from being started unless the gates are shut, and to prevent the gates from being opened unless the car is opposite them.

A flash-light position indicator is provided on each floor, with a series of lamps and special controlling gear, so as to show in the indicator on each floor the position of the car in the well-hole at any moment.

Messrs. Waygood-Otis, Ltd., also fitted two electric coal and service lifts, to take a load of 3 cwt. at a speed of 110 ft. per minute. The cars are of angle-iron frames filled in with oak. These lifts are operated on the automatic system, with a set of push-buttons on each floor, so that the car can be sent from any floor to any other floor, stopping automatically on reaching the desired level. An electric flash-light indicator is provided at each opening to show the position of the car.

Another interesting feature of the electrical equipment is the installation of some 60 electric clocks, supplied by The Silent Electric Clock Co. The master clock is the company's well-known standard pattern short-pendulum control clock, and is fixed in the elec-

trical plant room in the basement; the electrical impulse to the pendulum is provided by a modern application of the well-known "Hipp" principle, which is noiseless in action. The 55 receiving clocks, arranged in two circuits, are all of the company's patent silent rotary-armature pattern, and have been provided with handsome oak cases, in harmony with the oak panelling of the interior of the building. The installation is energised by a battery of Fuller "Block" accumulators at 40 volts, which is charged off the 220-volt circuit through a resistance. Each of the clock circuits takes a momentary current of ¼ A at half-minute intervals. The wiring for the clocks and bells was done by the Alpha Co., with v.i.r. cable in steel conduit.

Telephonic communication throughout the building is provided for by a Post Office private branch exchange.

The whole of the electrical equipment has been designed and carried out on the most up-to-date lines, with first-class materials and workmanship, and is in every way worthy of the important building in which it is installed. Our thanks are due to Mr. C. A. Baker for enabling us to inspect the installation and for explaining the features which we have described in this article.

THE BRITISH INDUSTRIES FAIR.

The British Industries Fair, which may be termed "Britain's shop-window," opened in London and Birmingham on Monday last; the Glasgow Section is, this year, a week behind the other two. Although the Fair of 1920 was an eminent success, and in spite of the dullness prevailing in industry, the organisers are looking forward to even better results. As in the previous year, it is at Birmingham that the engineering exhibits are to be found; the London section is devoted principally to fancy goods, toys, office appliances, &c., while Glasgow is to exhibit textile goods, food products, and chemicals. We intend to deal with some of the individual exhibits at Birmingham more fully in subsequent issues; at present, for the most part, we merely give the names of exhibitors of articles of interest to the electrical profession, trade, and industry, with an indication of the nature of their displays.

LONDON SECTION.

The London section of the Fair, which has again increased in size, and promises to surpass its predecessor even as that in its turn added to the roll of success since the Fair's inception in 1915, was opened at the White City, Shepherd's Bush, W. 12, on the 21st inst., and will remain open until March 4th. Producing trades are grouped for convenience of inspection, and the groups are again divided into sections and so housed as to facilitate a rapid survey of British products in any given line, a wise provision, since the space occupied by exhibitors' stands has grown in seven years from 80,000 to 240,000 sq. ft.

At the White City there are some 3½ miles of stand frontage, and the electric lighting of this temporary market town must have been a big undertaking in itself. In addition to 15 miles of "flex" and 6 miles of straining wire, some 20 miles of electric cable have been laid to supply the 6,000 lamps on exhibitors' stands. The Post Office has installed nearly 300 special telephones for individual exhibitors, in addition to the numerous call boxes and a number of post and telegraph offices distributed throughout the buildings.

An aggregate of 1,150 firms are exhibiting in the London section of the Fair, which is sectionalised into seven divisions broadly classified as follows: I, china, glass, and earthenware; II, fancy goods; III, paper, &c.; IV, drugs and scientific instruments; V, jewellery, silver, cutlery, clocks; VI, sports and toys; VII, furniture, basketware, and musical instruments.

On the whole the display is an imposing one, but there are few stands of direct electrical interest. In Division I the manufactures of the Deal Potteries, Ltd., include electrical porous pots, and Messrs. Doulton & Co., Ltd., show a selection of porcelain insulators of various types and sizes for l.p. and h.p. work. Glass bulbs and tubing as used in the manufacture of electric lamps are displayed on the stand of the Sheraton Glass Manufacturing Co., Ltd., while the Vauxhall Glass Manufacturing Co., Ltd., has on view flint and fancy glassware, shades, and both upright and inverted globes.

In Division II some new and unique designs in lamp shades and standards may be seen on the stand of the Artistic Shade Co., Ltd., the shades being made of silk, linen, or parchment; a speciality is made of hand painting, and the colour schemes are carried out in good artistic taste. Other stands on which similar exhibits are also shown are those of Miss M. Bruce Low; Messrs. S. L. Miller & Co., who specialise in hand-painted shades to match vases adapted for table lamps; Messrs. Charles Selz, and Messrs. Henry Wolff & Co.

In addition to fancy goods, Messrs. T. de la Rue & Co., Ltd., exhibit "Telenduron" insulators, and the Improved Solidite Co., Ltd., claims that its product can be moulded into any shape or form; it is produced in qualities suitable for machining, is supplied in nearly all colours, and can be used as a substitute for other insulating materials. Messrs. Siemens Bros. & Co., Ltd., have on view specimens of their dry-battery electric lighting equipments for bicycles and motor cycles, and a complete range of cells and batteries as manufactured at their Woolwich works. The Ever-Ready Co. (Great Britain), Ltd., besides batteries, is showing a variety of portable lamps and torches and electrical fancy articles; a number of the exhibits of the Semaphore Engineering Co., Ltd., are of a similar nature to those mentioned above.

In Division IV the laboratory apparatus shown on Messrs. Brown & Son's stand included electrically-heated muffles, while Messrs. S. G. Brown, Ltd., show a "Brown" gyroscopic compass, electrical relays, wireless telephone receivers, telegraph instruments, &c., and also the "Cyclux" cycle-lighting generating set. Amongst the photographic apparatus on Messrs. W. Butcher & Sons, Ltd., stand, kinematograph projectors, arc lamps, and resistances may be seen, and Messrs. A. Graham & Co. exhibit a selection of high-grade permanent magnets and loud-speaking telephones. As regards medical instruments, Messrs. W. Gowland (1916), Ltd., show, amongst many other things, electrical dental sets, and several types of electrical inspection lamp. The use of ozone for medical purposes is too well known to need description, and neither does it require any extra nasal sensitiveness to detect the stand of Messrs. Ozonair, Ltd. An interesting exhibit is provided by Messrs. J. Pilkin & Co., Ltd., in the form of an instrument for measuring the velocity of a bullet or projectile by electrical means. The firm includes in its manufactures electrical indicating and recording instruments and spiralising and other machines as used in electric lamp factories.

Division V includes only one stand of electrical interest, *i.e.*, that of the Magneta Time Co., Ltd., on which are shown electric clocks and synchronised time systems which do not employ batteries or contacts; also electrically-operated turret clocks and bell signalling apparatus.

In Division VI Messrs. A. Chase & Co., Ltd., exhibit a selection of their manufactures, such as small electric motors for driving toys, tapping keys, buzzers, signalling lamps, &c., and all kinds of electrical novelties and toys.

BIRMINGHAM SECTION.

The Castle Bromwich Aerodrome is again the site of the important Birmingham section of the Fair; although the number of exhibitors is practically the same as last year, the floor space taken up is considerably larger, and the fully representative character of the exhibits has been assured. The arrangement of the stands has been improved to a great extent, so that it is almost impossible for visitors to miss any section of the exhibits. Requisites for all classes of engineering are on view, and the domestic exhibits cover a wide range. Copper and bronze wares constitute a larger section of this year's display, indicating the determination of British manufacturers to maintain their supremacy in the face of foreign competition.

The catalogue issued by the organisers (Birmingham City Council and the Chamber of Commerce) is a marvel of compactness, considering the amount of information it contains. The alphabetical index of goods, indicating the stands on which they are to be found, is printed in English, French, and Spanish. Each of the six hundred-odd stands is given sufficient space in the catalogue to indicate thoroughly its nature.

The following is a list of firms exhibiting electrical goods or wares closely connected with the electrical industry. The stand number is given in each case.

BUILDING A.

Excelsior Shade Manufacturing Co., "Betterway" shades and electric lighting fittings 1
Donovan & Co., ironclad switchgear, factory and domestic apparatus, electrical accessories, insulators, &c. 6
David Shanks & Co., Ltd., electric light fittings 7
Wm. McGeoch & Co., Ltd., switchboards and fittings for ships, lamps for navigation and signalling, electric door locks, &c. 8
Improved Solidite Co., Ltd., "Solidite" moulded insulation 9
The Semaphore Engineering Co., Ltd., dry batteries for telephones and all purposes, complete lighting sets for cars and cycles 10
Berry's Electric Ltd., open type and ironclad switchgear for domestic, manufacturing, and colliery purposes, electric fires, instruments, &c. 12
Siemens Bros. & Co., Ltd., automatic telephones, signalling apparatus for mines, cables and wires, primary cells, car lighting equipments, and other electrical appliances ... 13
British Brass Fittings, Ltd., electric light fittings, switches, electric fires, tramway and railway fittings, &c. ... 14
Ingram & Kemp, Ltd., ditto. 15
Player & Mitchell, ditto 16
Sperryn & Co., Ltd., ditto 17
J. H. Tucker & Co., Ltd., electric lighting and power accessories, tumbler switches, lamp holders, wall sockets and plugs, switchboards, fuses, distribution boards, &c. ... 20
Gent & Co., Ltd., electric clocks, signalling apparatus, industrial telephones, bells, indicators, &c. 21
Sutcliffe (of Crumpsall), Ltd., vulcanised fibre tubes, rods, sheets, &c. 22
Electrical Conduits, Ltd., heavy and light gauge tubes, junction boxes, &c. 23
The Telephone Manufacturing Co. (1920), Ltd., automatic inter-communication telephones, "Laryngaphones," bells, terminals, junction boxes, and other accessories ... 24
Best & Lloyd, Ltd., ornamental fittings and shades for electric lighting 25
F. & C. Osler, Ltd., metal electric light fittings, crystal glass, and alabaster 26
Faraday & Son, Ltd., electric light fittings of various descriptions 27
The Etna Lighting & Heating Co., Ltd., electric lighting installations 28
Simplex Conduits, Ltd., conduit fittings and accessories, electric light fittings, ironclad distribution boards, ships' fittings, electric heating and cooking appliances, &c. ... 29
Premier Electric Heaters, Ltd., electrical domestic appliances for heating, cooking, &c. 31
Ebonestos Insulators, Ltd., moulded insulation 32
C. H. Parsons, Ltd., lamp holders, tumbler switches, and ironclad switches and fuses 35
Edward J. Shaw & Co., electrical fittings, lanterns, and cut glassware 39
Samuel Heath & Sons, Ltd., electrical fittings and accessories 42
The Vincent Switchgear Manufacturing Co., ironclad switch and fuse-gear, distribution boards, &c. 46
May & Padmore, Ltd., brass fittings, electric fires, irons, and cooking apparatus 49
T. Saveker, electroliers, pendants, table standards, &c. ... 50
The Rawlplug Co., Ltd., patent wall plugs for screws ... 52
Crofts & Assinder, Ltd., electrical fittings 59
Edgar A. J. Hooper, Ltd., electric light fittings 62
Wm. Soutter & Sons, Ltd., electric lighting and heating... 63
John A. Harry Hunt, electric light fittings 65
Stoves, Ltd., electric stoves 66
Thomas R. Carpenter, Ltd., electric lighting pendants, bowl fittings, standards, &c. 67
The B.E. Co. (of London and Birmingham), Ltd., all classes of lighting fittings and accessories, heating apparatus, irons, lamps, bells, and batteries 69
Wm. Sanders & Co., ironclad switchgear, distribution boards, battery switchboards, &c. 74
The Thermal Syndicate, Ltd., electric lighting pendants, bowl fittings, shades, &c. 76
Mark Webber, Ltd., small electric lighting, pumping, &c., sets 80
The National Gas Engine Co., Ltd., suction gas plants ... 80A
The General Electric Co., Ltd., electric light fittings and accessories, switchgear, flexible wires and cables, telephones, bells, medical apparatus, lamps, vacuum cleaners, cooking, heating, and ventilating apparatus ... 81
The Austin Motor Co., Ltd., small electric lighting sets ... 82
Fuller's United Electric Works, Ltd., storage batteries for lighting and general purposes—plate and block types—miners' lamps and equipment 83
The "Perfacta" Engineering Co., Ltd., "Perfecta" and "Super" boiler circulators 84
Townshends, Ltd., electric cooking and heating appliances 86
Falkirk Iron Co., Ltd., electric cookers and irons 90
Watertight Fittings, Ltd., electric light fittings, conduit boxes, switches, and fuses 93
Springs, Ltd., springs for all purposes 95
Crisp, Francis & Co., Ltd., electrical fittings 97
Parker, Winder & Achurch, Ltd., dynamos, electric lighting outfits, electric floor polisher, &c. 100 and 529
Imperial Contractors Machinery Co., concrete mixers ... 102
The Birmingham Mica Co., Ltd., mica and micanite insulation 104
Wm. Whitehouse, Ltd., electric light fittings 105
Accles & Shelvoke, Ltd., fractional h.p. motors, patent dynamotor, lighting dynamos for cars, &c. 106
Electric Heating & Hardware, Ltd., "Komet" electrical products 107
Gath Electrical Engineering Co., electric light and bell accessories 108
Watts, Williams & Co., Ltd., electric lighting sets for cycles and motor cycles 115
Singleton & Rome, electric light fittings, pendants, brackets, standards, accumulators, heaters, &c. 118
The Central Gear Co., Ltd., applications of heliocentric reduction gears to electric motors, fans, &c. 130
Metallurgical Co., Ltd., ingots of non-ferrous metals ... 134
Parc, Ltd., jigs and fixtures for repetition work and mass production 493
John Slater, Ltd., paraffin engine suitable for small lighting set 494
Factory Equipment Co., machine tools, jigs, gauges, &c. 496
John Rigby & Sons, Ltd., iron, steel, and brass wires and bars 501
Wm. Beardmore & Co., Ltd., pumps for petrol, oil, water, &c. 510
Coleman & Appleby, Ltd., electro-plating plant and chemicals 520
G. Jones & Co., electro-plating plants, dynamos, &c. ... 526
E. Camelinat & Co., Ltd., electric lighting sets for cars and cycles 527
Clayton-Wright Bros., "Pedlite" lighting sets 528
British Cellulose & Chemical Manufacturing Co., Ltd., non-inflammable celluloid, glass substitute, &c. 530
Apollo Plug Manufacturing Co., Ltd., electric horns and sparking plugs 539
H. Miller & Co., Ltd., dynamo lighting sets for motor cycles 543
Reavell & Co., Ltd., totally-enclosed air compressors ... 548
Scarab Oil Burning Co., Ltd., patent oil burners for boilers, &c. 548A
Ransomes, Sims & Jeffries, Ltd., electric truck with electric elevating platform 549
F. H. Adams, Ltd., aluminium die castings for motor-car magnetos, dynamos, starting motors, &c. 550
New British Electric Supply Co., Ltd., totally enclosed motors 552
The Hockley Chemical Co., Ltd., electro-plating chemicals and accessories 559
Motor Trading & Garage Supply Co., Ltd., accumulator and dynamo car and cycle lighting sets 560
Birmingham Small Arms Co., Ltd., machine tool accessories, cycle lighting sets, &c. 571-6
Thomas Howse, Ltd., insulating varnishes and compounds 583
The Frederick Crane Chemical Co., Ltd., colouring and frosting preparations for electric lamps 589
Nightingale & Co., lubricating oils and greases 600
Pinchin, Johnson & Co., Ltd., insulating varnishes, compounds, &c. 605

BUILDING B.

Henry Wiggin & Co., Ltd., nickel products, anodes, salts, resistance wire and tape, &c. 137
T. J. Priestman, non-ferrous alloys 143
McKechnie Bros., Ltd., extruded brass and brnoze rods in all sections 145
Galloways, Ltd., super-heaters, boiler tubes, boiler accessories, &c. 148
London Simplex Engineering Co., Ltd., boiler water circulators 150
Brass & Copper Tube Association, seamless tubes for boilers, &c. 151-221
Brass Wire Association, brass, phosphor bronze, bronze, &c., wires 151-221
Brazed Brass Tube Association 151-221
Cold Rolled Brass & Copper Association, all sizes of brass, copper, and brass alloy strip, sheets, tapes, &c. ... 151-221
Nickel Silver Association 151-221
Association of Drop Forgers and Stampers, boiler fittings, electrical fittings, &c. 222
Bloxwich Lock & Stamping Co., electrical fittings 225
Lancashire Ordnance Accessories Co., Ltd., electrical fittings 237
The Aston Chain & Hook Co., Ltd., turbine blading, &c. ... 246
Brooks & Adams, Ltd., brass die pressings and stampings for the electrical trades 253
British Electric Vehicles, Ltd., 4-ton electric locomotive and electric industrial truck 254
Thomas Piggott & Co., Ltd., pressed steel tanks, &c. ... 258
Mansill, Booth & Co., Ltd., brass, white metal, and phosphor bronze stampings for the electrical trades 267
A. E. Lefever, light-gauge, solid-drawn brass and copper tubes for the electrical trades 276
The New Rotoplunge Pump Co., Ltd., electrically-driven pumps 422
J. H. Fenner & Co., Ltd., belting of various types 425
The Midland Supply Co., electric monorail and friction hoists, winches, and pulley blocks 430
William Robinson, electric hoists, telephers, winches, &c.... 431
Rayner & Heald, Ltd., two- and three-phase motors ... 432

The "M. & P." Electric Welding Machine Co., lifting magnets and resistance welding machines 433
The Consolidated Pneumatic Tool Co., Ltd., electric drills and grinders 435
John Hill & Sons, electric pulley blocks, &c. 440
Hollings & Guest, Ltd., insulating press with hot plates ... 441
H. C. Slingsby, electric carrying and lifting trucks ... 448
R. & J. Dick, Ltd., "Balata" belting 458
W. Goodyear & Sons, Ltd., 2-ton "Greenbat" electric truck 467
The Pneulec Machine Co., electrically-operated jar ram moulding machine 472

BUILDING C.

The Springvale Engineering Co., Ltd., official electrical contractors to the Fair 283
The Hoover Suction Sweeper Co., Ltd., electric suction sweepers 333
The "Daisy" Vacuum Cleaner Co., Ltd., electric vacuum cleaners 345
Thomas Pemberton & Sons, Ltd., brass-foundry work for electrical purposes, &c. 373
Evered & Co., Ltd., electrical fittings, alabaster bowls, &c. 376
Simmons Holloware Co., Ltd., electric lamps and reflectors 380
Scholey & Co., Ltd., electric suction cleaners and electric drills 391
The Electric Appliances Co., Ltd., electric vacuum cleaners 395
James Smellie, Ltd., electrical fittings, &c. 407

THE EFFICIENCY EXHIBITION.

(*Concluded from p.* 199.)

THE exhibits of the UNIVERSITY OF LONDON are intended to illustrate the teaching and research work of the University as carried out at the incorporated colleges and its schools. The exhibit of the Electrical Engineering Department of University College, London (Prof. J. A. Fleming, F.R.S.), includes several items of practical and historical interest, such as samples of the original instruments of research which led Prof. Fleming to the important invention of the thermionic valve; he also exhibits the original oscillation valves which he first employed in 1904 as detectors of electric waves in wireless telegraphy, and also many of the later developments, such as the three-electrode valves, &c. Other apparatus exhibited comprises phonoscopes, or instruments for photographing the wave form of sounds, which were made at University College, London, during researches which assisted the Admiralty in the anti-submarine warfare.

The KING'S COLLEGE Department of Geology exhibit illustrates teaching and research work as carried on in the department by Prof. W. T. Gordon, Mr. A. K. Wells, and Mr. L. D. Stamp. A process in the examination of minerals by means of converging polarised light on definitely orientated slices of crystals is included. In commerce such a method is employed in selecting and differentiating mica fo rinsulating purposes in electrical machinery, and for other uses.

The WHEATSTONE LABORATORY'S exhibit of historical apparatus from the George III Museum, King's College, is of great interest as illustrating the history of discovery in electrical science. The Wheatstone Laboratory is the oldest physical laboratory in the country open to students. The professors at King's College have included such men as Maxwell, Wheatstone, Hopkinson, H. A. Wilson, Barkla, and O. W. Richardson, all of whom have been or are well-known leaders in electrical progress. Some of the apparatus devised by them and by other distinguished scientists working in the laboratory is shown in the exhibit.

The Metallurgical Department of the UNIVERSITY OF SHEFFIELD illustrates its wartime activity in the production of cupro-nickel; the Department of Glass Technology shows, amongst other things, an electrically pre-heated blowpipe burner, while the Electrical Engineering Research Department demonstrates Dr. T. F. Wall's method for producing sparkless operation of inductive electrical circuits and its practical applications.

ARMSTRONG COLLEGE, Newcastle-on-Tyne, exhibits Dr. Benson's apparatus for determining the liability to explosion of coal dust and the inhibitory power of inert dust. The apparatus consists of a glass bulb within which are placed a few grains of the dust to be examined; by means of a puff of air the dust is blown against a source of heat, such as a red-hot platinum wire, and if the dust is capable of producing a colliery explosion, a small flash of light is seen in the globe, and the amount of energy developed is registered on a pressure gauge attached to the bulb.

The whole of the articles exhibited by the LOUGHBOROUGH COLLEGE, including electrical fittings, are the work of students, who include a large number of ex-officers and disabled ex-service men.

THE DOMINION MACHINERY CO., LTD., demonstrates a number of electrically-driven wood-working machines, showing that complicated operations can be carried out with the same facility as simple ones.

MESSRS. OZONAIR, LTD., show various types of portable and stationary apparatus for the electrical production of pure ozone. On this stand may also be seen a Wild-Barfield electric furnace which is flat in contrast to the more usual cylindrical shape.

THE BRITISH THOMSON-HOUSTON CO., LTD., has a handsome stand on which is assembled some of its more novel and recent apparatus; for example, an automatic d.c. arc welder is demonstrated, the operation of which is started and stopped by means of a push-button switch; butt welds can be made at speeds varying from 4 to 20 in. per minute, and metal deposited at rates varying from 1 to 4½ lb. per hour. The welding head consists of a steel body carrying feed rolls and adjusting and straightening rolls, which draw the electrode wire from the reel, straighten it, and feed it to the work, while provision is made for such hand adjustment as may occasionally be necessary. The feed rolls are driven by a d.c. motor, the fields of which are excited from a separate source of d.c., the armature being connected across the arc between the electrode and the work. Therefore, as the arc tends to lengthen, the speed of the motor will increase and feed the electrode wire more rapidly; this brings the arc length and arc voltage back to their normal values. The reverse operation occurs if the arc length tends to shorten. Control is automatic through the medium of relays and contactors for regulating the feed motor, together with rheostats for adjusting the speed to suit various sizes of electrode wire. The moment contact is made the potential between electrode and work falls to zero, which causes a contactor on the control panel to operate, thereby reversing the feed motor and withdrawing the electrode wire from the work a distance sufficient to establish the proper arc length. The motor thereafter continues to feed the electrode wire to the arc at the correct speed. The equipment may be held stationary and the work travelled past the arc, or the welding head may be movable and the work held stationary; a lathe, planer, or boring mill may be used for the purpose, thus a spiral of metal can be laid so that each succeeding layer will fuse into the previous one. If desired, the operation of the welder can be made entirely automatic by means of interlocks on the control panel. The welder has been operated continuously for 16 hours without breaking the arc. Other articles shown by the firm include motors, control gear, a Tirrill regulator panel, flow meters for measuring the flow of liquids and gases in pipes, an electric rivet heater, a portable wireless telegraph receiving set weighing 20 lb. which needs an aerial, a portable Coolidge X-ray outfit which can be operated at the bedside of the patient, a "Tungar" battery-charger, and Mazda lamps and fittings.

THE MARCONI COMPANIES have a large exhibit of modern wireless telegraph and telephone apparatus, embracing valve transmitters and receivers; also complete ships' installations and field sets for military and surveying or other similar purposes.

THE EASTERN ASSOCIATED TELEGRAPH COMPANIES show a demonstration circuit comprising a keyboard perforator and Wheatstone transmitter at the sending end, and an electrolytic magnifier, "Jockey" and intermediate relays, perforators, and a printer at the receiving end, the apparatus being a duplicate set of that used on the London-Alexandria circuit. Other exhibits include the original model of the siphon recorder by Sir W. Thomson (Lord Kelvin), specimens of cable and "faults," marine growths, fish bites, &c.; repairing tools and gear, and models of the s.s. *Lady Denison Pender* and the bed of the Atlantic Ocean showing the positions of cables. Messages can be accepted at the company's stand for direct transmission to places abroad at the usual rates.

MESSRS. CREED & CO., LTD., have arranged a somewhat similar exhibit to that described above, but illustrating a 1920 pattern Creed high-speed automatic printing telegraph circuit. The messages are prepared in punched slip form at one end of the stand, and received at the other in printed Roman characters, the working speed being 175 words per minute. Musical selections are also rendered at intervals on the "Stentorphone," an instrument of the gramophone type, but possessing great power.

MESSRS. BARR & STROUD, LTD., demonstrate the practical utility of the optophone, an instrument for enabling the totally blind to read ordinary print by using the sense of hearing instead of that of sight. How each letter of the alphabet is represented by different combinations of five, or less, musical notes, was fully described in our pages a week or two ago. Miss Mary Jameson can be seen at the exhibition reading ordinary printed matter selected by members of the public. Miss Jameson has been blind from birth, and can testify to the facility with which a person can learn to use the instrument, of the capabilities of which we have personal knowledge.

MESSRS. BELLING & CO. show many examples of their various designs of electric radiators and convectors for heating purposes, as well as water boilers and hot plates, &c.

THE HOBART MANUFACTURING CO., LTD., has a stand on which is displayed a number of electrical machines that will appeal to those interested in the preparation of food in any manner. They include such devices as cake and dough mixers, loaf moulders and rounders, coffee mills, sausage and mincing machines, and many other electrical labour-saving machines.

THE DUROLITE MANUFACTURING CO., LTD., exhibits specimens of "Klydo" animated signs adapted for electrical and

other means of illumination. Only one light is used in each sign which gives a moving rainbow effect with good diffusion.

The Beck Kinematograph Manufacturing Co., Ltd., show two portable kinematograph projectors designed for lecture, educational, or home entertainment purposes. The firm is also responsible for the complete installation in the Minor Hall of the Exhibition, where trade and commercial films are shown daily.

Three firms have on view self-contained petrol-electric generating plant suitable for lighting country houses, farms, &c. The "Dayton" automatic set is shown by the T.B.S. Electrical Construction Co., Ltd., and the "Ballot" 1-kW, 50/70-volt set by Messrs. Hick-Diesel Oil Engines, Ltd. The latter firm's plant includes a wall-type marble switchboard and a 28-cell, 75-Ah Fuller battery on a wooden stand. The single-cylinder, four-stroke engine is cooled in a novel way by means of a mechanical water cooler forming part of the set, so that no water tanks are needed.

Messrs. Mark Webber, Ltd., also exhibited a 2-kW, 70-volt set for the same purpose on the stand occupied by the United Oil and Coal Corporation, Ltd.; this stand also contained one or two examples of "Railodok" electric industrial trucks, which, as their name implies, are suitable for carrying goods about on railway premises, docks, &c.; the trucks are supplied by Industrial Appliances, Ltd. Another stand which was devoted entirely to trucks of various types and sizes, including electrically-propelled ones of the solo and trailer hauling and elevating platform types, was that occupied by Messrs. H. C. Slingsby.

Telephones, mostly for private use, are displayed on two stands, namely, those of the London Telephone (New System) Co., Ltd., and the Reliance Telephone Co., Ltd., and the exhibits comprise instruments of various types and sizes, switchboards, cable, and accessories suitable for intercommunication purposes in offices, factories, ships, &c. An interesting exhibit is the "round call" signal system which enables an extensive range of departments in a building to be instantaneously searched for an individual who is required to speak on the telephone. The use of the "Laryngaphone," which defies noise, is also demonstrated; it is shown as a hand set for use in conjunction with any ordinary type of telephone, and also as a head set for the use of divers and airmen, or in connection with helmets and masks for mine rescue work, &c. The Phonotas Co., Ltd., has a stand illustrating its system for the periodical cleansing and sterilising of telephones.

An interesting exhibit is that of Messrs. Chance Bros. and Co., Ltd., which, in addition to samples of special glass, includes specimens of "Chance's Daylight Glass," through which light from gasfilled lamps is filtered for colour-matching purposes. Numerous coloured objects are shown illuminated by filtered and ordinary light, and the variations of the colours are in many cases very striking. The firm has also on view a new heat-resisting glass suitable for lamp globes, &c., which can be sprayed with water while hot without any ill effects taking place.

In conclusion, it might be mentioned that of the various receptions and conferences held at the Exhibition, those of the Electrical Development Association were of most electrical interest, but it is to be regretted that neither of the functions was well attended. Mr. Ll. B. Atkinson, president of the Institution of Electrical Engineers, presided at the conference in the absence of Mr. C. H. Wordingham, and Mr. J. C. Wigham opened the proceedings with a lecture on the application of electric power in industry, in the course of which he pointed out the advantages that accrued from its use and how it tended to promote efficiency. By means of a number of excellent lantern slides the lecturer indicated the methods of electric motor driving in textile, colliery, factory, and other spheres of activity.

JOINT ELECTRICITY AUTHORITIES.

The Chester and North Wales Inquiry.

At the Llandudno Town Hall, on February 15th, a public inquiry was opened by the Electricity Commissioners with reference to the schemes for the supply of electrical energy to the North Wales and Chester electricity district. Sir John Snell, the chairman of the Commissioners, presided, and a large number of authorities, companies, and private persons interested in the schemes were represented.

Summary.

Our summary of the proceedings last week (p. 210) broke off on Wednesday afternoon, with Mr. Britton in the chair. There was at the end of the afternoon a curious incident, showing the disadvantage of questions being put by counsel (unless specialists in scientific work); a lot of time was wasted in convincing an incredulous counsel that it was not necessary to put a weir and notch across a wide river in order to obtain a fairly accurate idea of the quantity of water flowing.

On the Thursday Mr. Britton occupied the witness chair for the whole day. During the morning the North Wales Power Co.'s counsel, Mr. Miller, tried to shake his figures for the number of units to be obtained from the Dee, but in all fairness it must be said that he failed. Mr. Miller was more successful in respect of the Clwyd Valley hydro-electric proposal, and elicited an admission that there was no spare plant there, yet the distributing mains were to remain isolated from the general system for a number of years. Mr. Tyldesley Jones, for the North-Western Railway Co., made a very serious attempt to shake the witness, and succeeded in showing that there were mistakes, although they were not vital ones. Sir John Snell intervened several times to preserve a sense of proportion, and after lunch some amended figures were put in and others promised. Most of the afternoon was wasted on this bickering, but counsel, who was extremely clever and competent as a calculator, made no substantial use of the new figures when they were put in. If some of the time thus wasted in the early days of the inquiry had been saved, it would have been unnecessary, later in the proceedings, to request all who could do so to substitute written for oral statements. However, it is perhaps premature to expect the Commissioners at this early stage of development to resist learned counsel in their skilled obstruction. The late afternoon was very entertaining to those interested in the habits of salmon. Mr. Moon, counsel for the Dee Fishery Board, made great play with an old Act of Parliament requiring all mills to shut down on Sundays, and he caught Mr. Britton rather neatly as to the state of tide when Mr. Britton thought he had seen salmon ascending the fish pass. A suggestion that the Dee was frozen solid at times was neatly countered by Mr. Britton.

An important statement was elicited by Sir Harry Haward that localities which did not undertake financial responsibility would have to be supplied on the same terms as if they were paying a deficiency rate. This is inevitable, but it is a deplorable fact which strikes a blow at voluntary joint authorities. In the absence of public spirit and self-sacrifice, the selfish will benefit at the expense of those who realise their responsibilities for the common good.

The Town Clerk of Crewe pointed out the need of the far eastern salt areas for an immediate supply, and showed it to be at least as urgent as that of Chester and its environs, which would obtain it under the scheme.

On the Friday morning Sir John Snell stated that the Commissioners were getting rather concerned as to the length of the inquiry.

Mr. Britton was subjected to further cross-examination in respect of supply to collieries near Wrexham, and it was very difficult to convince the questioner that the small summer flow of the Dee would not make the supply unreliable; he evidently wanted the steam station shifted to his district—having no doubt an eye to business.

The Northwich U.D.C., represented by Mr. Cowley, evidently wants its area excluded, oblivious of the fact that the large Rural District Council which surrounds it wishes to be included—a Gilbertian situation. Mr. W. Fennell followed on behalf of the Northwich Company, urging the adoption of a bulk supply from the Mersey Power Co. as a means of giving an immediate supply to the salt areas, without necessitating exclusion, this to be retained as a stand-by connection for summer use in times of drought, &c., when the trunk main came through from Chester. Mr. Fennell attempted to draw the Commissioners as to the policy of interlinking adjoining electricity districts generally, but failed. He further urged upon the witness the necessity of joining up to the North Wales Power Company at once, but no satisfactory reply was obtained.

Mr. Amos Jones, of Rhyl, was more successful in drawing the Commissioners. He obtained a very important pronouncement, to the effect that if any undertaker could show that his works could, if extended, supply its surroundings at a cheaper rate than the bulk scheme, he would be allowed to proceed.

At the end of his cross-examination Mr. Britton agreed with Sir John Snell that it was possible that the North Wales water power would be more favourable than that of the Dee, but information had not been available. Mr. Britton received a well-earned commendation from the Commissioners in respect of the valuable pioneer work he had done.

A very interesting witness, Mr. W. H. Armistead, was called, who gave evidence in a delightful way as to the very slight effect on the salmon fishery of a series of weirs provided with proper passes for the fish.

Sir Henry Robertson, deputy chairman of the Fishery Board, also gave evidence on the other side. It is unfortunate that such matters, however interesting in themselves, should have occupied such a large share of time.

Late in the afternoon Mr. Miller, K.C., opened on behalf of the North Wales Power Co., whose scheme was described in our pages on February 11th.

At the end of the proceedings for the day, the Town Clerk of Wolverhampton appeared with Mr. S. T. Allen, the chairman of the Engineers' Committee of the Joint Conference, North-West Midlands, to explain why the areas in the vicinity of Congleton and Macclesfield have been refused by that body, and to ask that their inclusion in the North Wales and Chester area should be considered. The subject is one which will occupy a considerable amount of attention, as extremities of the new electricity districts are, in the absence of any decision as to interlinking, very difficult to allocate.

The following day (Saturday) the Commissioners decided to sit as usual (morning and afternoon) so providing those who attend the inquiry with excellent evidence that this is not a mere holiday at a watering place.

Mr. Miller's opening continued, and provided amusing inter-

ludes by reason of his Saxon attempts to pronounce names only intended for Celtic tongues.

Mr. J. H. Jack was called, and disclosed a very interesting situation in relation to the position of the North Wales Power Company and the Aluminium Corporation—he had difficulty in dividing himself. The engineering scheme, it must be said, is very attractive, and the general feeling cannot be anything but favourable to it. The question, however, whether the company, admittedly weak financially, should be given an enormously greater area, with the assistance of a mere advisory committee provided in an undefined manner from the different parts of the area, is a serious one which, it was clear, would give the Commissioners much trouble and great responsibility. The company disclosed a considerable measure of support from the North Wales area, but little from the Cheshire section of the electricity district. Mr. Jack gave his evidence in a confident manner, and must be congratulated on receiving much more gentle treatment in cross-examination than that accorded to his opponents.

There is no doubt, as a result of this inquiry, that the side which engages eminent counsel, when the other relies upon the best of town clerks, is at a disadvantage. Counsel should either be excluded or employed by both sides in these inquiries.

It appeared at the end of the sitting that a vital agreement between the North Wales Power Company and the Aluminium Corporation as to the use of the Dolgarrog water resources had only reached the stage of being vaguely in Mr. Jack's mind. This revelation indicates the complicated condition of affairs in North Wales. The agreement was drafted during the week-end, and was produced on Monday morning, and it was promptly pulled to pieces by opponents. The cross-examination of Mr. Jack by the Town Clerk of Chester produced some spirited passages, and it confirmed the feeling that the technical scheme was good and the proposed organisation a difficult proposition.

Mr. Tyldesley Jones, for the Railway Companies, asked many questions and made points, but it was clear he was neutral rather than in opposition.

On Tuesday eminent engineers were heard, all confirming the good opinion we have formed of the Welsh water power, and finally there was a remarkable speech from Mr. Tyldesley Jones, in which he, in the railway interest, opposed the formation of a Joint Electricity Authority. It was expected that the inquiry would finish at noon on Wednesday.

Mr. J. H. Dickson, town clerk of Chester, in opening the case for the Chester or "B" scheme, said that a preliminary survey of the area showed great diversity of industrial development and population. The area was approximately 4,000 square miles, with a population of about 900,000, and a rateable value of more than four and a half million pounds. It embraced really two distinct districts. The Corporation arranged that all common interests should be grouped, but provision was made against one authority being able to swamp the Board. It was thought that only one-fourth of the authorities and persons who had the right to be represented on the Board would join in the first instance. It was believed that the rest would eventually join. It had been agreed that the railway companies should have small representation on the proposed Board, which in that way would have the benefit of the co-operation and assistance of their technical experts. The Corporation had considered it of the utmost importance that the Joint Electricity Authority should not in the initial stages be overweighted with capital outlay; it therefore did not propose that the authority should buy out any existing generating stations or interfere with the North Wales Power Co. in its existing operations. Hydro-electric generating stations involved a much greater capital outlay than steam stations. In addition, there would be long lines of transmission through sparsely populated districts which would require very little current, and the expenditure would have to be incurred straightaway at present inflated prices. Therefore, the idea of conveying electricity from the west to the east would be entirely out of the question in the early stages. In the meantime the demand for the current in the east was very urgent, and it was believed that the soundest proposal was that the east should at once be developed from an up-to-date steam generating station set up on the banks of the Lower Dee, in conjunction with a series of hydro-electric low-fall stations on the Upper Dee. In the west the North Wales Power Co. would continue to operate. Its transmission lines would be gradually extended over the area, and as the development proceeded, the extension from the east would meet the extension from the west. In the Vale of Clwyd, the southern area of Merionethshire, Montgomery, and a portion of Cardigan, there were many sources of water power, and the proposed authority would, as part of its early work, make careful survey of these natural resources and ascertain how far they were capable of development on an economic basis. The scheme would encourage the development of local efforts such as those at Machynlleth, Dolgelley, and also near Aberystwyth. Certain financial proposals were said to be *ultra vires*. It was essential that the authority should have a financial backing, and provision should be made to meet any small deficit, but there was no reason to fear the provision dealing with that matter. If any deficit occurred during the initial stages of the working of the scheme, provision was made to enable the repayment to be made to the authorities out of a reserve fund, which could be built up from future surpluses. The North Wales Power Co. had lodged an objection, claiming that the Chester scheme was fundamentally unsound. The Dee Fishery Board had also made an objection on the ground that the fishing would be ruined. The assertion in the objection that the Chester hydro-electric works had proved a detriment to the Dee salmon fisheries was not admitted.

Mr. Dickson enumerated authorities in Cheshire which supported the scheme, and said that Wrexham borough supported the policy of public control embodied in the Chester scheme, but did not wish that a steam generating station should be erected unless the Commissioners were satisfied that it was absolutely necessary. It also desired compensation for discarded generating plant, but that was not a proposal that the promoters could accept. They were, however, satisfied that the different authorities could be supplied with electricity in bulk at such a price as would enable them to discard their generating plant without undue loss. Connah's Quay Urban Council contended that the administrative part of the scheme was repulsive, and alleged that the technical portion of the scheme was not conducive to a cheap and abundant supply of electricity. Rhyl Urban Council desired to perpetuate the old parochial system. He gathered that the eastern district supported the principle of public control and favoured scheme B. Several county councils were against public control and against scheme B.

At this point the chairman intimated that only those authorities and interests who had made representations on the Chester scheme would be allowed to cross-examine witnesses, with the exception of the Ministry of Agriculture and the United Westminster Collieries, Wrexham, both of whom had been unavoidably prevented from making such representations.

Mr. E. Noel Humphreys, of Chester, who was for a year the chairman of the Chester Corporation Electricity Committee, and who, since his resignation from the council, had been co-opted as a member of the committee, then gave evidence. He stated that he was until 1918 the managing director of the North Wales Power Co. His evidence-in-chief covered the points referred to in Mr. Dickson's opening, and dealt with the changes in the scheme which had been made as the result of negotiations and conferences subsequent to its being filed with the Commissioners. The proposed Joint Electricity Authority would at first comprise 74 members. The financial clauses need not alarm any of the authorities. The North Wales Power Co. had been invited to all the conferences that had been held, and there was power under the scheme for it to come in.

In reply to the chairman, Mr. Humphreys said there was a very serious fall in the rainfall in 1915, and that drought would have been disastrous to the east portion of the district had it then relied upon a supply from hydro-generating stations. A committee representing the Chester Corporation and other authorities had been negotiating with the Government to take over the steam generating station at the Government factory, Queensferry, and an arrangement was expected to be concluded without delay.

Mr. Humphreys was cross-examined by Mr. Harper, for the North Wales Power Co. Asked whether he would expect a public control scheme to be adopted even if the current supplied under public control was more costly than that supplied by a private company, witness replied affirmatively, provided the disparity were not too great. He would prefer the private supply, assuming there were permanent guarantees of quantity and price. He saw no reason why a publicly-controlled authority should not provide power as cheaply as the Power Co.

Mr. Tyldesley Jones, K.C., who appeared for all the railway companies concerned, except the Cambrian, inquired whether it was proposed to make uniform charges for current in all parts of the area. Mr. Humphreys replied that the supply was not expected as cheaply in the eastern area as many consumers in the west were already getting it.

Referring to Mr. Humphreys's statement that this was not the time to purchase generating stations, Mr. Jones asked whether it was meant to purchase undertakings at a later date. The witness replied that the North Wales Power Co.'s scheme disclosed some capital outlay valuation figures and estimates of expenditure, which—particularly the valuation figures—were considered by the promoters of the Chester scheme as inflated. It was not contemplated to purchase any other generating stations.

Replying to Mr. A. Moon, representing the Dee Conservancy Board, witness denied that the proposed weirs on the upper Dee, nine in number, would ruin the salmon fishery or the river. The promoters had expert advice on that matter.

Mr. W. O. Jones, clerk of the Anglesey County Council, suggested that if his county joined the proposed electricity district it could not expect a better supply than was available from the Power Co., and the witness concurred. He could not agree to priority of supply being given to areas not already provided for.

The inquiry was adjourned.

The examination of Mr. Humphreys was resumed on Wednesday morning when Mr. Cowley, of the Northwich U.D.C., further questioned him as to whether under the scheme the County Council would levy the rate for any deficiency on the whole county or for any specific district. Mr. Humphreys said that in the case of a county council

it would be paid out of the general county fund. He was not prepared to accept an amendment giving urban authorities the same facilities for contracting out as county councils.

Mr. H. C. Vincent, representing the North Wales quarry owners, who, he said, were the largest users of electricity in the district, asked the witness if any local authority would accept any financial responsibility. On this point the witness had no information to give beyond what he gave in evidence. The large consumers in the western area were not approached on the matter further than inviting them to the conferences. So far as the west was concerned, they did not propose to carry out any operations.

How do you propose to carry out your obligations in the west?—We can help you to come to reasonable terms with the Power Co.

Yes, but supposing you fail, what would happen then?

The Chairman: If there was failure to supply there would be legal power to remedy the matter.

Mr. Humphreys said that under Section 14 of the 1919 Act there were means of bringing pressure to bear through the Commissioners on the Power Co. He could not conceive that such circumstances would arise, as they were being supplied already.

Mr. Johnson: Then I come back to the original point. What advantage would it be for us to come in as a contributing authority under this scheme? We should get our electricity from the same source, and we should have the doubtful privilege of contributing towards your deficiency when it occurs, which we do not consider an advantage.—You would have that under either scheme.

Mr. T. Amos Jones, clerk to the Rhyl Urban District Council, said that his council objected to the scheme. He noticed that the district would not be developed at the commencement of the scheme. Mr. Humphreys said that it would be left to the authority to develop the district later. He was satisfied as to the estimated charges of 1½d. to 2d. per unit. They were not prepared to insert a clause for a maximum charge, as it generally became a minimum charge.

The Chairman (to Mr. Jones): If you join you will have a voice in the direction of affairs.

Mr. Jones: And if we join we will be taking on an unknown responsibility. So far as Rhyl and Denbigh were concerned, he said, the scheme was not a commercial proposition. Rhyl was capable of generating its own supply, and could also supply the district around if necessary.

The Chairman said the Commissioners would have due regard to that wish. Pending developments, if places like Rhyl desired to dispose of their surplus energy the authority set up could consider it.

Mr. Nethersole, clerk to the Connah's Quay U.D.C., said his council had decided to support the North Wales Power Co.'s scheme with certain amendments.

Mr. Lawson Taylor, town clerk of Wrexham, questioned Mr. Humphreys on the proposals to scrap existing plant without making any provision for meeting outstanding loans.

Mr. Humphreys replied that he did not think there was any hardship. They would have the advantage of cheaper electricity, which would make it a commercial proposition to scrap the works rather than carry them on at a loss. It was thought better to provide electricity at such a price that places like Wrexham would find it cheaper to buy in bulk than carry on their own works.

In replying to Mr. Williams, clerk to the Chester Rural Council, who suggested that any deficit should fall upon the consumer rather than the general ratepayer, Mr. Humphreys said the latter arrangement was devised in order to give the proposed authority better financial support, and to enable money to be got on the best terms.

Mr. Cartwright, clerk to the Nantwich Rural Council, said his council desired it to be made clear that those who used the electricity should be made to pay for it, and that the burden of any deficiency should not be put upon rural areas which could not obtain a supply of electricity.

Sir Harry Haward inquired what authorities had passed resolutions supporting the scheme.—No authority has distinctly supported the scheme except Chester.

In reply to questions as to what inducement Chester had to offer the various authorities to come into the scheme, Mr. Humphreys said that by managing and owning their own electricity the authorities would be able to control the price and have the advantage of any surplus that might accrue. He placed great stress on the authorities concerned taking the financial responsibilities of the undertaking, and said that, if possible, the rates should not be resorted to. The prospect of a deficiency rate was somewhat remote.

The Chairman: With regard to the capital involved in the scheme (£914,000), do you consider there would be any difficulty in raising the money?—No; of course it would depend on the money market.

Replying to further questions by a Commissioner, Mr. Humphreys said he was aware that the North Wales Power Co. was not purchasable. On the other hand, if the Power Co. wished to give a supply in bulk to other than authorised undertakings in any local government area, it would have to proceed by a special order from the Commissioners, or alternatively, by Act of Parliament.

Can you realise what would be the relations between the Joint Authority and the North Wales Power Co. seeing that they are not purchasable?—We hope it will be one of friendly co-operation so that the area will get the fullest benefit.

The Chairman: There are apparently two things which make you shy of water power—occasional drought and the unreliability of transmission lines. If you were assured that the water power was so developed as to make provision for adequate storage so as to eliminate the risk of even an unusual drought, and you were assured by your technical advisers that your fears as to transmission lines were groundless, would you then be prepared, if it were cheaper, to take your supply for the eastern area from the water power?—Until experience has proved we are wrong we think not.

This ended the examination of Mr. Humphreys, who had been in the witness chair about eight hours.

Mr. S. E. Britton, M.I.E.E., electrical engineer to the Chester Corporation, was the next witness. Examined by Mr. Dickson, he dealt with the scheme from its technical aspect, and said that the development of electricity in the district had been slower than it ought to be, owing to the absence of power supply. A cheaper rate for electricity would tend to increase the demand, as there were great possibilities of industrial development, and also of the use of electricity in agricultural areas in the same way as had taken place in Herefordshire. The water-power in the area was of such magnitude that if developed it would tend to economise the generation of electricity in large quantities. The Chester scheme embraced the utilisation of the river Dee by constructing low-fall hydro-electric stations and the erection of a steam generating station on the Dee, which would act as a safeguard against failure of supply. He considered it essential to prevent any risk of interruption of supply. Dealing with the objections of the Fisheries Board, he said that in the erection of the weirs on the Dee they proposed to provide fish passes similar to the one in existence, and there was no evidence that the weir was detrimental to the salmon or salmon fry. Witness also described the water power source in the Vale of Clwyd.

The Chairman: You heard the objection made by Rhyl that they were able to look after the district themselves. From the figures given in the Chester scheme the average cost per unit was 6.794d. From what you say now the cost would be reduced by about one-half if water power were utilised?—Yes.

Mr. Britton then went on to state that until they got their proposed power station they would get the current they required from the Queen's Ferry factory. He gave figures of the expected consumption, and the expenditure of the £914,000 involved in the first period of development. The cost of a six-wire transmission line would be £2,300 per mile, and for a single line £1,800 per mile. The cost per unit at first would be 1.369d., which would be reduced to 1.029d. in five years. In the first five years the total cost would be £472,650, with estimated receipts of £517,500.

The Chairman: So the net profit would be £45,000 after all capital charges, new plant, and transmission lines had been provided for?—Yes.

Mr. Britton was then cross-examined by Mr. A. T. Miller, K.C., representing the North Wales Power Co., on the proposed construction of the low-fall power stations and the weirs on the river Dee, and as to the figures he had arrived at in estimating the flow of the river, and the electricity that would be generated, especially in reference to the fact that in the summer the river had very little flow.

Mr. Britton described how he had arrived at his estimates, and said he had caused gauges to be placed in the river at various points.

At this stage the proceedings were adjourned.

Mr. Britton's cross-examination by Mr. Miller was continued when the inquiry was resumed on Thursday morning. Questioned regarding the capacity of the proposed new low-fall plant to be constructed on the Dee, as given in his report to the Board of Agriculture and Fisheries in 1919, he agreed that the maximum was 6,505 kW and the minimum 929 kW, the minimum being a seventh of the maximum, not a fourth, as had been stated previously.

Mr. Miller then questioned witness as to his figures regarding the maximum and minimum flow of the river, and witness replied that the maximum was 75,000 cu. ft. per minute, and the minimum was 11,000 cu. ft. per minute.

Mr. Miller: Can you tell me in arriving at those figures which add up to 929 kW average per month minimum output what efficiency factor over-all have you calculated on?

Mr. Britton: Over-all 65 per cent.

Mr. Miller: Have you got before you the details of that over-all efficiency, because I desire to challenge it?

Mr. Britton: No; I have not the details here in connection with the scheme.

Mr. Miller: My experts put it down under the low-water conditions which are, of course, special ones, at 33 per cent.

Mr. Britton: I must challenge that until I am satisfied it is correct.

Mr. Miller: It is a very serious difference, and I must inquire into it a little. These are, I assume, your steps. First your turbine, then your gearing, then through the gearing to the direct-current generator and over the direct transmission lines which go into the motor generator at the central station, passing it to the step-up transformer, which delivers your current. Are you able to tell me what your allowance is for each of those items, starting with the turbine and taking them in order?

Mr. Britton: Including the turbine, gearing, and direct-current generator, 65 per cent.

Mr. Miller then put a series of questions with a view of challenging this figure, when the chairman interposed, and remarked: "I do not want for one moment to protect the witness, but the Commissioners have very full opportunities of examining such efficiency curves as you refer to, and are able to check them. Your point, Mr. Miller, is with only one-seventh of the flow the efficiency of the six stages to which you refer, from turbine to step-up transformer, will not be as high as 65 per cent., which the witness has stated, and that, in fact, it will not be higher, in the opinion of your experts, than 33 or 35 per cent. I have made a note of that, and we will pay particular attention to the point. I would like you to give us this if you will. If your experts give the opinion that the 33 per cent. is for the six stages, would you give it for the three stages. That is, for the turbine, the gearing, and the direct-current generator, so that we may have a comparative figure with the 65 per cent."

Mr. Miller: I will get that worked out for the three stages. As they stand separately they are 55 per cent. turbine, 95 per cent. gearing, 85 per cent. direct-current generator. The direct-current transmission we put at about 98 per cent. efficiency, the motor generator at 81 per cent. efficiency, and the step-up transformer at 95 per cent. efficiency.

The Chairman: I suggest there must be some little mistake there; if you suggest that for a direct-current generator with that particular load the efficiency is only 85 per cent., can the motor generator be as high as 81 per cent.?

Mr. Miller: I will ask my experts to consider that. The total worked out on all these calculations will be 33 per cent.

Mr. Miller: In regard to your £65,000 outlay on a small station in the Vale of Clwyd, you place the kW capacity at 1,000 in 1930. Is that the demand which you expect to supply from the Vale of Clwyd?

Mr. Britton: That is the figure as to the potential supply of the district. After further technical questions on this point, the chairman interposed and said: May I put this question to you? In your scheme you have not made any provision up to 1930 for any connection between Rhyl and the Vale of Clwyd hydro station with any other part of the general transmission system in the eastern district.

Mr. Britton: That is so, the figures do not include a connecting link between the river Dee and the western district.

Questioned by Mr. Miller as to the cost set down in the scheme for producing 15,300,000 units, fuel would cost £23,900, and the cost would be .375d. per unit generally, Mr. Britton replied that the cost was based on 2d. per unit generated for coal at 35s. per ton.

Mr. Miller also questioned the witness's figures of a capital outlay of £27 10s. per kW, and asked for the detailed figures, which the town clerk of Chester promised would be supplied. In regard to the item £28,875 for capital charges which was questioned, the chairman pointed out the figure was based upon the tables for loans which the Commissioners invariably grant, the amount of interest being 7¾ per cent.

The Chairman: Supposing that it be a fact that there is surplus water power which can be generated in the west and which cannot be wholly utilised in the west, and supposing as you have said that the transmission lines can be erected at such a cost that energy can be economically delivered to the east, is it your opinion as an engineer, and would it not be your wish as one of the promoters of this scheme, that such transmission lines should be laid as soon as possible and the energy supplied to the east?

Mr. Britton: Certainly, sir. The whole point is, we are not in a position to put forward an opinion on that particular point, as we have not the detailed information. There is nothing else in it. If it can be shown that the west can generate large quantities of power there and send it to the east at a proper charge, we are quite prepared to say it would be the proper thing to do, but that is the point—we have not the information.

Mr. Tyldesley Jones, K.C., on behalf of the railway companies, then cross-examined Mr. Britton, and said he would like the witness to explain what this paragraph in his scheme meant: "The electrification of railways is considered an important national matter, and having regard to the exceptional circumstances existing in this district for the generation of cheap electrical energy this is worthy of early serious consideration."

Mr. Britton: First there is a coalfield in the area, adjacent to a river, enabling a steam generating station to be put up and electricity produced in very large quantities at a very low rate. Then you have the water power, as submitted by the Power Co. in the west. Those two conditions, I think, are peculiar, and do offer facilities for generating great quantities of electricity for railway electrification.

In replying to further questions by counsel, the witness admitted that at present Chester was only able to carry its load by means of a battery and occasional overloading of the plant. He also admitted that Chester would not transfer its hydro-electric station to the proposed Joint Electricity Authority, but would use it itself.

Mr. Jones also elicited the fact that it was proposed to lay 123 miles of mains in the first period of development.

Questioned as to the operating costs, the witness said the figures were based upon actual experience of the running costs of the installation at Queensferry.

(To be continued.)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Reduction in Price of Lamps.

I should like to associate myself with the remarks of Mr. R. J. Scarborough in the last issue of the Electrical Review, and to say that I also have written the E.L.M.A. and notified them that until I obtain a rebate for all lamps in stock on February 1st, 1921, I will sell no more T.L.A. lamps.

The remedy is in our hands, but only by concerted action shall we obtain satisfaction.

If all other retailers so affected will adopt the same plan we shall get the rebate. The travellers will soon be round, and when they find their usual orders missing, they, too, will no doubt press the matter.

C. Culmer Hodges, A.M.I.E.E., A.M.I.Mech.E.,
Electricity Works, Dawlish.
February 15th, 1921.

I should be glad if you could find space for a few words in reply to your correspondents' comments, regarding my letter on the reduction in the price of lamps. Your correspondent Mr. Rudd's suggestion of a clearing house would have left no room for complaints, although even a month or two's notice to the trade would have given retailers an opportunity to arrange their stocks.

As regards your correspondent "Lamp Salesman," one would appreciate his reply had he come out into the open and revealed his identity instead of hiding behind a *nom de guerre*. However, the reason is obvious. But he has forgotten that at the time when the price of lamps was increased there were more important things to be done than sitting in an office or selling lamps behind a counter; hence I had no stocks to increase in value, and no cheque to forward to the lamp manufacturers, so that Mr. Salesman can now be convinced on that point with greater amusement on seeing that he has fired a blank shot. But even if the increased value was given to the trade at the time, no doubt the retailers' stocks were low owing to war demands. It was the makers, and not the retailers, who reaped the harvest. And, after all, the average 25 per cent. discount off E.L.M.A. lamps is not a great proposition when breakages in stock, complaints of premature failures, &c., are considered. Since my first letter I have received several letters from contractors and retailers each stating that they have communicated with the E.L.M.A., who have not at present even had the courtesy to reply.

Probably this is mismanagement.

R. J. Scarborough.
North Finchley.
February 19th, 1921.

Wiring in Ferro-Concrete Factories.

The use of ferro-concrete in the construction of buildings opens out new problems in the matter of distribution and wiring systems, and I think it would be of general interest to have the opinions of others as to which is the best system to adopt in factories, built on this principle.

It is held by some engineers that the use of steel tubing in any form, screwed or otherwise, is bad practice, and wood casing, of course, is out of the question. C.T.S. cables strike me as being rather too unprotected for general use, although, of course, ideal for some classes of work, and there are several metal cased wiring systems which no doubt have their supporters. Among the latter is the concentric system with earthed outer, which can, of course, only be used on systems not connected to a general or central station supply.

It would be interesting to have the experience of users of this system with special regard to its reliability and fire-proofness.

Inquirer.
February 16th, 1921.

Shop Displays.

The letters under the heading of "Shop Displays" have greatly interested me, particularly those criticising the Electrical Contractors' Association.

I am absolutely certain that all electrical contractors outside the association do not realise the tremendous work that has been done by our united efforts, particularly during the last three years.

They may have been misinformed, like myself, as to the integrity of our leaders. My only regret is that I listened to the tales of a certain wholesaler's traveller (whose name I still remember) instead of seeking direct information myself, and was thereby unduly influenced against the association for some years.

Since joining about four years ago, I have got to know a large number of our members, and find them, particularly our leaders, exceptionally capable and square dealing men

who are out for the general advantage of our section of the electrical industry.

I feel heartily sorry for contractors who are qualified and have not joined; they are losing more than they realise, and if I can personally give useful information to any of them I shall be delighted to do so.

H. T. Young.

London.
February 16th, 1921.

Charging Batteries for Motor Cars.

With reference to our communication re battery-charging plant in motor garages, I would point out to your correspondents that our correspondent perhaps did not make himself as clear as he might have done.

What we actually require is a charging system which eliminates the loss by heat or light when using a resistance or bank of lamps. I already have a good system for charging with resistance so that the whole current consumed equals the battery which takes the highest current. This, however, is not what we require, and we should be glad to hear from makers who have a system in which neither a motor generator, nor resistance, nor banks of lamps are used in reducing the voltage from the main.

W. Evans,
Electrician, Rootes, Ltd.

Maidstone.
February 16th, 1921.

A Question of Ethics.

What appears to me to be an unusual breach of advertising ethics appears in your current issue. In the advertisement pages (*i.e.*, page 57 of the Supplement) is a quarter-page advertisement drawing attention to a "write-up" *and giving the page number in your news columns on which it may be found.*

I am not a bit concerned commercially in any type of the machine advertised, but I am concerned in keeping advertising free from base suggestion by its traducers. Thus, while I am justified in asking if this new departure is to be taken as a part of your future policy, I am hopeful that a slip has been made which will not be repeated.

Editorial comment should be quite independent of any advertiser, and, in my opinion, it is both bad for a journal and for advertising generally, when such evidence of prior arrangement between the advertiser and the journal appears in its columns.

W. A. Moore.

London.
February 22nd, 1921.

[We are indebted to our correspondent for drawing attention to this incident. We think it is well known throughout the trade that we hold very strong views regarding the absolute necessity for the completest possible independence to be maintained with regard to editorial contents. The insertion of the reference was not sanctioned either by ourselves or by our advertising manager, and steps have been taken which, we hope, will render a repetition of the incident impossible.—Eds. Elec. Rev.]

A Flashing Problem.

Some time ago two 40-h.p., d.c., shunt interpole motors, both of reputable English make, were moved from one factory to another part of the country; both motors had worked satisfactorily at No. 1 factory, and on starting up after installing at No. 2 factory ran sparklessly until nearing full load, when both sparked violently. The voltage in both cases was 440. The insulation on test was O.K., also a drop test on shunt and interpole coils showed a perfect balance. Nothing would correct this faulty commutator until the interpole circuit was reversed. To do this, the short lead of copper tape from the interpole coil to the + brush arm had to be lengthened to reach the terminal block, showing clearly that the original connection was as intended by the test bed results of the maker. Further, the motors had developed their full rating at No. 1 factory. The motors never gave trouble afterwards, but I never satisfied myself why this alteration was necessary, and should like to hear of any similar experience on the part of any of your readers.

Inquirer.

Referring to "Dense's" letter in the issue of February 11th and the several replies thereto in the succeeding issue, perhaps the following comments may help to clear up the difficulty.

Since the motor runs in one direction sparklessly, it proves that it is not loaded in excess of its commutating power, and that the brushes are of a quality fit to give good commutation results provided the flux element is correctly adjusted.

The fundamental principle underlying correct commutation is that when certain coils of the armature pass from a magnetic zone of one sense to a zone of an opposite sense, during which time the commutator bars to which they are immediately connected are passing beneath a set of brushes, the current in these coils must be reduced to zero, reversed, and built up to an equal strength in the opposite direction.

To bring this about, the brushes are rocked to a position such that during the time the coils are shorted by them, the coils are being cut by a fringe of flux sufficiently strong and of such sense as to build up the necessary reversed current in them before their commutator bars emerge from beneath the brushes.

The position of this fringe of flux tends to vary with every change of current in the armature, and in order to keep the coils within its influence the brushes must be suitable rocked.

The function of the interpole is to compensate for this tendency of the flux to move, and by so doing allow of a fixed brush position.

It would appear that when "Dense's" motor runs sparklessly it does so not solely by virtue of the influence of the interpole, but only partially so, and the discrepancy is compensated for by adjusting the brushes so that the coils catch up, so to speak, the aforementioned fringe of flux.

To make the interpole function properly, its flux strength must be so proportioned to the flux due to the armature ampere-turns that the resultant flux of the interaction of armature and field fluxes will remain at a fixed angle.

If "Dense" will try varying the strength of his interpole flux (as suggested by Mr. Kinch), I think he will find therein the solution to his difficulty.

E. Brown.

London.
February 19th, 1921.

I desire to thank you for your courtesy and your correspondents for their very interesting letters re the above. I have acted on several of the suggestions mentioned, but after I have had an opportunity of looking further into the matter (which may be some little time) I will have pleasure in communicating with you if I succeed in solving the problem.

Dense.

February 19th, 1921.

[This correspondence is now closed.—Eds. Elec. Rev.]

LEGAL.

F. Holbrook & Co. *v.* F. P. Bliss & Sons.

Mr. Edward Pollock, one of the High Court Official Referees, on February 16th concluded the hearing of this action, in which plaintiffs, electrical engineers and contractors, of Foster Lane, Cheapside, claimed from defendants, builders, of Rudolph Road, Bushey, the balance of an account for an electrical installation put into a house called "Oaklands," at the Avenue, Bushey.

Mr. J. B. Matthews, K.C., with Mr. Abinger appeared for the plaintiffs, and Mr. A. Powell, K.C., was for the defence.

Mr. J. B. Matthews, stating the case for the plaintiffs, said that it was really a trade dispute between tradesmen doing similar business as to the cost of doing certain work in relation to the fitting up of a private house with an electrical installation. In April of last year the defendants were doing certain building work at the "Oaklands," into which a lady named Giffard was anxious to move, and plaintiffs received from them a telephone message stating that they wished to have some electrical work done, and in the course of the conversation defendants said that it was a job which ought to cost from £50 to £60. Mr. Holbrook went down to the place and saw Mr. Cyril Bliss, who had the matter in hand. On going over the house and seeing what was required, Mr. Holbrook told Mr. Bliss that it certainly was not a £60 job, and how much it would cost it was not possible to say. It was costly work, as the wires were to be cased in steel tubing laid not on the surfaces but in chases to be made in the walls. The work was put in hand, and the result of the anxiety of the lady to get it done quickly was that men had to work night and day which involved extra outlay for labour at overtime, and while the work was in progress Mrs. Giffard wanted a good many things done in a way different from that which was originally intended. Indeed, said counsel, she exercised a lady's privilege of changing her mind and having things restored to the original condition after she had altered them. Beyond the electrical installation for lighting there was an establishment of points for the purpose of radiators being fixed, and there was a special estimate for the rewiring of the electric bells. The end of it was that the total amount of the work, including a costly list of fittings chosen by the lady or her husband, came to £275, against which there was a cash credit of £179. The plaintiffs, however, arrived at the balance of £96 by making the largest possible concessions in favour of the defendants. The issues to be tried, said counsel, were two: First, that there was a contract that the work should be done for £60, and secondly, there was a question raised with regard to the wiring of the bells. It seemed that the working did not turn out satisfactory, and it was found by plaintiffs that water had got into a portion of the work, but for that plaintiffs were in no way responsible. Defendants further said that the work was not done so well as it ought to have been done, and in respect of that they made a small counter-claim of some £14.

Plaintiff gave evidence in support of the claim, and witnesses were called to testify to the details of the work done, with additions occasioned by alterations ordered by Mrs. Giffard, the owner of the house. Several electrical engineers also gave evidence as to the efficiency of the installation and the moderation of the prices charged.

For the defence, Mr. Robert Giffard and Mrs. Giffard, the occupants of the house, were called, and while complaining of the cost of the work, asserted that the bells were left in a defective condition. Mrs. Giffard denied that she had caused a great deal of extra work, but admitted that she had caused alterations to be made after the lights had been fitted.

Mr. Cyril Bliss, who had charge of the work at Oaklands, stated that he left the work of electrical installation entirely to Mr. Joseph Holbrook, and took no responsibility for it. Mr. Holbrook's price of £60 was not, he said, to include the cost of the fittings, and the order for putting in the wires for the bells was given afterwards. When the bill was sent in it was three times as large as he expected, and when he took it to Mr. Giffard he told him how disgusted he was at having to ask for so much money. Accounting for what he termed the heavy charges for labour, he said that at starting there were four men walking about the building and doing nothing but mark the walls with crosses during the whole of one day because they had brought no materials with them, and the materials were brought down in " dribs and drabs " at different times.

In cross-examination, he said he told plaintiffs that it was a heating as well as lighting job of 28 points, but it turned out that there were 32 points for lighting and four radiator points. He admitted that it was not true to say that the men came down without any materials, because they did bring a bag down with them. He was thoroughly disgusted with Mr. Holbrook's charges, but in a postscript to a letter he had told them that he would pay their bill as soon as he obtained a settlement from his client. He said nothing about excessive charges.

Expert evidence was called on the question of the alleged excessive charges, and in the result

The Official Referee, in giving judgment, said that £50 had been paid into court, and the question was whether that was sufficient to cover plaintiffs' claim. When Mr. Holbrook went over the premises he said the job was quite different from that which he had expected, and it could not be done for £60. He declined to give an estimate. There was no mention in any letter that there had been an agreement to do it for £60 or any other amount, nor was anything said about it when plaintiffs pressed for payment. He (the Referee) could not help coming to the conclusion that the evidence of Mr. Holbrook was right and the evidence of Mr. Bliss was wrong. As to the prices, there were great differences of opinion, but that was what must always be expected where experts were called. A detailed account had been sent in, and no one had been able to say that the materials charged for had not been used, and no one had taken the trouble to ascertain whether the charges were excessive. Mr. Holbrook had, however, said that the charges were fair and reasonable, and he could not accept the suggestion that there had been any overcharge. A considerable amount of time had been spent over the suggestion that the use of slip-sockets was wrong, but there was abundant evidence to show that they were used almost universally. As a result he found that the plaintiffs had made out their claim, and there must be judgment in their favour, the £50 paid into court to be paid out to them in part satisfaction.

Judgment was accordingly entered for the plaintiff, with costs on the High Courts scale.

Watson, Marsh & Co. (Hampstead) *v.* Cohen.

In this action, which was commenced in the Chancery Division by Mr. Justice Eve on February 16th, and concluded on the following day, the plaintiffs, according to Mr. Clayton, K.C., who appeared for them, sought to obtain an injunction to restrain the defendant from committing a breach of an agreement entered into in August, 1917, in which there was a covenant that he should not, for a period of five years from the completion of the purchase by plaintiffs of a business at Golders Green Road which he had sold to them, carry on or engage in the business of an electrician within a certain radius of Golders Green Road. Defendant, however, who was now trading as an electrician at Cheapside, in the City, had a house near his old premises at Golders Green, and he there used the same telephone number as he had used previously in his business.

His Lordship, in the result, after hearing evidence, gave judgment for the defendant.

Llanrwst Electricity Supply Co., Ltd.

At the Festiniog County Court, last week, an application was made on behalf of a petitioner for the winding up of this company. Mr. Latimer Jones, of Llanrwst, appeared against granting the petition. He stated that he represented four-fifths of the value of the company's shares. Judgment was reserved.

British Electrical Federation, Ltd.

In the Chancery Division, on February 16th, Mr. Justice Astbury confirmed an alteration of the objects of the British Electrical Federation, Ltd. Mr. N. Greene said the company did not carry on business at a profit. Its sole business was protecting and assisting its members who comprised a large number of electrical firms, and it was found desirable that the company should act as trustee in respect of matters such as superannuation pensions and debenture issues of its members. The company not being a trading one had no creditors.

BUSINESS NOTES.

Bankruptcy Proceedings.—James Sherred Denley (trading as Denley & Co.), cycle dealer and electrician, 69, Regent Street, Cheltenham. The following are creditors in this case :—

Callender's Cable Co., Ltd. ..	£21	Wholesale Electric Co., Ltd. ..	£11
General Electric Co., Ltd. ..	34		

Charles Carlisle Thompson, 78, Salisbury Street, Kingston-upon-Hull, plumber and electrician.—The public examination of this debtor was recently held at Hull. The statement of affairs showed liabilities £295, against assets £14. Debtor attributed his position to losses on contracts, illness of self and family, and heavy household expenses. The examination was closed. The following are creditors herein :—

Danby & Co., Ltd...	£145	Singleton, Frank	£46
Darby, Ltd., Jas.	37	Hull Corporation Telephones ..	11
Morley, T. B.	36	Bankers	10

J. V. Bell, electrical engineer, 21, North Bar Within, Beverley, Yorkshire.—First meeting, March 1st, at Official Receiver's office, Hull. Public examination, March 14th, at the Guildhall, Hull.

J. W. Gladwin, electrical engineer, Sheffield. — Trustee, Mr. C. Turner, 155, Norfolk Street, Sheffield.

Company Liquidations.—Mutual Electric Trust, Ltd.—Winding up voluntarily. Liquidator, Mr. A. E. Wake, Norfolk House, Laurence Pountney Hill, E.C. 4. Meeting of creditors, February 28th, at Laurence Pountney Hill.

Trade Announcements.—The Dawson-Manley Engineering Co., of 24, Hatton Garden, London, E.C. 1, desires to receive catalogues from the electrical trade.

Messrs. A. W. Sainsbury, Ltd., engineers and electrical contractors, Sheffield, celebrated the firm's coming of age by removing into new premises built for them in Campo Lane (Sainsbury's Buildings). The firm desire to receive up-to-date catalogues.

The Ironsides Co., of Columbus, Ohio, U.S.A., has just established an agency in this country for the sale of the Ironside roll neck and gear shield greases, which are extensively used in U.S. rolling mills. Mr. John Hanlon, 61A, Bold Street, Liverpool, has been appointed sole European agent for all the Ironside specialities.

Messrs. Cleworth, Wheal & Co., Ltd., of Castleton, Manchester, manufacturers of air filters, coolers, humidifiers, &c., are now represented in the London district by Messrs. Williams, Pell and Baring, of 5, Chancery Lane, W.C. 2.

Catalogues and Lists.—The Premier Accumulator Co., Ltd., Cattle Market Road, Northampton.—A well-illustrated catalogue of accumulator batteries, giving a number of views of installations. Fully priced.

Messrs. Hamnett & Andrew, 127, Grosvenor Street, All Saints, Manchester. List 723, giving particulars of a number of insulating materials, including fibre, ebonite, mica, silk and cotton.

Messrs. Isaacson & Brown, Ltd., 39, Furnival Street, Holborn, E.C. 4.—A priced and illustrated leaflet of " Bettalite " bowl fittings.

Messrs. S. Smith & Sons (M.A.), Ltd., 179-185, Great Portland Street, W. 1.—Literature describing the " K.L.G." spark-plug, and giving details of a competition being organised among users of this plug.

Fuller's United Electric Works, Ltd., Iddesleigh House, Caxton Street, Westminster, S.W. 1.—Lists Nos. 91, dealing with dry batteries, giving dimensions and prices; 93, miners' lamp accumulators—describing manufacture; 97, price list of plate-type lighting accumulators; and 104, illustrating and describing Fuller's patent inert cells.

Messrs. Spalding & Hodge, Ltd., Drury House, Russell Street, W.C. 2.—Illustrations of various types of motor-lorries.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflet No. O 2,641, illustrating and describing the " Klesite " dynamo for lighting commercial vehicles. Installation Leaflet No. P 2,450, an illustrated description of a 1,750-kVA low-speed alternator for a water turbine. Pamphlet No. F 2,475, a price list of " Superlux " ornamental glassware for lighting; priced and illustrated.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—An illustrated booklet giving constructional details of the " Plexaire Royal " electric vacuum cleaner. Priced.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—A price list of a number of types of " Hart " starter and lighting batteries.

Swedish General Electric, Ltd., 5, Chancery Lane, W.C. 2.—Stock Lists Nos. 28 and 29, dealing respectively with d.c. type "K" motors and single phase "Century" motors, and two- and three-phase motors. Fully priced.

Messrs. Bruce Peebles & Co., Ltd., Edinburgh.—"Les Convertisseurs en Cascade 'Peebles,'" Brochure F 20, an illustrated list (in French) dealing with the construction and applications of "Peebles" converters.

The Electric Heating Co., George Street, Croydon.—An illustrated and priced pamphlet dealing with "Elect" irons, including a tailor's "goose" type.

Messrs. E. Brook, Ltd., Empress Works, Huddersfield.—List 53, giving details and prices of Brook three-phase mine motors.

Messrs. Marsh & Sanderson, 35, Station Road, Oasett, Yorks.—An illustrated leaflet describing "M & S" safety switch covers for protecting switches from mechanical damage.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W. 1.—A new supplement (No. 3) to the firm's catalogue of wire and cable (No. 532), dated February, 1921, and giving prices, &c., of cab-tire sheathed cable and flexibles.

Erith's Engineering Co., Ltd., 83, Kingsway, London, W.C. 2.—A 24-page well-produced booklet fully illustrating and describing Erith-Roe three-stage combustion stokers, supplementary firing with waste gases, mechanical coal-handling and stoking for vessels, and Erith's feed-water heater and purifier.

The Waltham Manufacturing Co., 2, Jackson Road, Holloway, N.—Priced leaflet dealing with lantern arc lamps.

Messrs. Todman, Ryall & Co., Ltd., 38, Grosvenor Gardens, Westminster, S.W. 1.—Illustrated and priced catalogue describing the general construction of "L W" dynamos and motors, and giving h.p. or kW and various speeds.

Swedish Foreign Trade.—According to the foreign trade returns of Sweden, the imports and exports in the past two years included the following:—

Imports.	1919. Tons.	1920. Tons.
Electrical generators, motors, stators, accumulators, &c.	4,088	12,716
Safety apparatus, rheostats, &c.	428	791
Glow lamps	215	262
Electricity meters	3,864	4,367

Exports.	1919. Tons.	1920. Tons.
Electrical generators, motors, stators, &c. ...	11,330	18,190
Telephone and telegraph apparatus	10,022	10,675
Steam turbines	3,483	3,793
Hydraulic turbines and water-wheels ...	1,358	1,086

For Sale.—By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction on March 10th, at Swindon, machine tools, electrical plant and fittings, &c. On March 15th, 16th, and 17th, at Newport, Mon., machinery, office furniture, and canteen equipment, and on March 22nd and 23rd, at Bristol, a quantity of shipbuilding plant, electric generators, motors, cables, &c., lying at Beachley, Portishead, Portbury, Bath, &c.

Messrs. J. Pearce Pope & Sons will offer by auction on March 11th, at the National Filling Factory, Quedgeley, Glos., plant, machinery, building material, &c.

Beckenham Urban District Council Electricity Department has for disposal one 120-kW Bellis-Fowler alternator and exciter.

Wolverhampton Corporation Electricity Department has for disposal eight steam-driven "E" type underfeed mechanical stokers, with hoppers, &c. See our advertisement pages to-day.

We have received a catalogue of motor accessories which are being offered in a special clearance sale by Messrs. S. Smith & Sons (M.A.), Ltd., until March 7th.

German Firms in Luxemburg.—It is reported that the Siemens-Schuckert Co. proposes to follow the example of the A.E.G. and establish a branch in Luxemburg.

Exhibition at Algiers.—An Exhibition Fair will be held at Algiers from April 16th to May 8th. This exhibition will be installed on a site of about 10 acres in a suburb of the town. The principal exhibits will comprise food products, various industries, native industries, textiles, metallurgical industries, &c., automobile and motor-culture industries. Application for stands and all information should be addressed to Monsieur C. Granier, 1, Boulevard de la Republique, Algiers. We have received a copy of the prospectus.

Competition in Portugal.—"Conditions of sale" are an increasingly important factor in trade operations with foreign countries, in view of exchange and other difficulties. Attention has already been drawn to complaints at the stringent terms required by British manufacturers in comparison with those of other nations, and particularly of Germany, and to the consequent danger of loss of trade. The following instance, quoted by the F.B.I. representative in Portugal, proves yet again the urgency of the question. An important Portuguese company recently invited tenders for the supply of machinery of which it was in need. The British firms tendering asked for half payment with order and the remainder on shipment of the goods. The order was finally placed with a German firm in Spain whose terms were far more favourable. The machinery was delivered by this firm, and had been for three weeks on the wharf before any question of payment arose. A member of the Portuguese company then called on the German firm and was informed that as the Spanish exchange was so bad at present for the Portuguese firm, they were quite willing to await payment until it was more favourable to the purchasers.—*Bulletin* of the F.B.I.

A New German Development.—A further movement in the German electrical industry is impending, as a result of the announcement that the A.E.G., of Berlin, and the Linke-Hofmann Works, of Breslau, have decided to enter into a community of interests by means of an interchange of shares for 30,000,000 marks. The former will make a new issue of shares for 30,000,000 marks for this purpose, even if the emission should not assume larger dimensions, while the share capital of the latter is to be raised from 64 millions to 120 millions of marks, so as to effect the interchange and for other purposes; and there will be a mutual election of directors on each company. As one of the largest locomotive works in Europe, the Linke-Hofmann Co. entered into a close connection with the Lauchhammer Iron and Steel Co. in 1920, and thus became assured of a supply of raw materials. The transaction with the A.E.G., which has been aimed at by the latter for some time past, is understood to have in view unity of action in connection with electric railway problems which are pending in various countries in Europe. The Breslau Works are considered suitable also for the construction of electric locomotives and wagons, while the A.E.G. would be a large customer for the former's special manufactures, which apart from steam locomotives, include compressors, winding engines, turbines, &c.

Lead.—In their report dated February 19th, Messrs. James Forster & Co. state:—"There has been a fair amount of business this week, chiefly for prompt, but makers of red, white, and sheet lead report that the demand from the building trade is very poor, and worse than it has been for some months past, which is somewhat surprising, in view of the building which is going on. On the other hand, the electrical cable trade is well employed, and is likely to remain so for months ahead. Export is stagnant."

Ex-Service Men's Bazaar.—An Ex-Service Men's Industrial Bazaar has been opened at 52, Conduit Street, London, W., and is full of interesting and useful things, says the *Daily News*, including a pleasing display of art lamps and electrical domestic apparatus.

Key Industries.—The *Birmingham Post*, in a forecast of the Government's new Trade Bill, designed to protect key industries, prevent dumping, and remedy the disturbance caused by collapsed exchanges, says it is possible that the measure will be introduced into the House of Commons for a formal first reading this week. "The scheme proposed by the Board of Trade is that an import duty shall be placed on the goods sent from countries with collapsed exchanges, not with the intention of cutting out competition, but to give our manufacturers a fair chance with the home markets. The duty, which will seek to establish a parity between the price of the imported goods and the price of the home-made goods, will rise or fall with the exchange rate, the variations being arranged over a period of weeks, and not day by day. The schedule of 'key' industries included in the Bill will practically be the same as the schedule in the previous Bill introduced by Sir Auckland Geddes when he was President of the Board of Trade. The list includes at least two items of importance to the Midlands—magnetos and hosiery needles—while fine chemicals is another item in the schedule. While this part of the Bill is very much the same as before, the clauses dealing with dumping have been considerably modified. The Board of Trade will not be given absolute authority to deal with dumping, as would have been the case had the previous Bill become law, and the safeguards provided will, it is hoped, meet the objections of many Free Traders. The proposal is that an independent Committee shall be set up to examine complaints about dumping. This Committee will report its findings to the Board of Trade, which has the authority to act upon the recommendations made."

25th Anniversary.—We congratulate Messrs. Ernest F. Moy, Ltd., of Greenland Place, Camden Town, N.W., on having attained their 25th anniversary. In celebration of the event, a company of nearly 100 sat down to dinner last Saturday, under the chairmanship of Mr. Ernest F. Moy. After a programme of music and song had been rendered, Mr. W. B. Dykes proposed "The Firm," which he said was launched by Mr. Moy and a few gallant stalwarts in 1896. He referred to the great strides which the firm had made. The employés had put their backs into the work, and were always ready to adapt themselves to circumstances. They did not go to America for their foremen, they were all the developments of the firm. The employés wished to express their appreciation of the managing director, Mr. Moy; and Mr. Dykes, on their behalf, presented him with a cut-glass silver-mounted tantalus. Mr. Moy responded. Mr. P. H. Bastie, one of the directors, proposed "The Visitors," and Major Tegetmeier responded. Having watched the development of Messrs. Moy's business since the day of small things in 1896, we wish them a record of even greater progress and prosperity during the next quarter century.

Patent Application.—Application has been made by Mr. J. D. Haworth for the restoration of patent No. 2,045, of 1915, for "Improvements in electric accumulators."

Australian Prohibition of Bosch.—In June last the Australian Commonwealth Government issued a proclamation prohibiting the importation into the Commonwealth of magnetos bearing the word 'Bosch.' The restrictions against the firm which employs this title have now been extended, and all goods bearing the word "Bosch" have been placed on the prohibited list by the Department of Customs.—*Reuter's Trade Service* (Melbourne).

German Electrical Trade.—The correspondent in Germany of the Federation of British Industries has reported on the progress of German engineering and electrical industries, and in the issue of the *Bulletin* of the Federation for February 15th, the following notes appear regarding the electrical situation:—

"As a result of the reduction in the supply of coal to all industries, there has been a considerable increase in the demand for electric power. In order to cope satisfactorily with this demand the erection of very large power stations on the coalfields themselves is becoming necessary. At Dortmund the various big electricity works of Western Germany have formed a Committee to draw up a plan for the construction of a single giant power station.

"Export trade is much brisker than business at home. In spite of the recent fall of the mark, prices in some branches of the electrical industry are still so high that exports are only possible at prices below those quoted for the home trade. Thus, the Official Labour *Gazette* recently reported that export business in the electromotor, dynamo and transformer industry was increasing, but that all of it was done at very low prices—below those current in the home market.

"The electric cable industry had a bad year during 1920. Goods sold abroad during the first six months did not total as much as 30 per cent. of the pre-war figure and during the last half year fell below 25 per cent. Sales in Germany ceased altogether.

"The position of the lamp industry was rather more favourable. It has always been largely concerned with foreign buyers, as about half of its total pre-war production used to be sent abroad. Germany's best markets in those days were Austria-Hungary and Russia. The Osram-Gesellschaft, which is a union of the Allgemeine Elektrizitätsgesellschaft, the Siemens-Halske Aktiengesellschaft and the Auer Gesellschaft, now controls seven-eighths of the German electric light bulb production. It appears to aim at gaining a complete monopoly of this industry. At the end of 1920 this company obtained control of the largest German factory making glass for electric bulbs (the Lausitzer Glaswerke). It is consequently in a very strong position for a struggle with the few factories still remaining outside the combine.

"Generally speaking, the position of the electrical trade may be considered moderately good."

Air Service to British Industries Fair.—Owing to the enterprise of the *Mercantile Guardian*, visitors to the section of the Fair at Castle Bromwich will be able to save time by making the journey by aeroplane. An arrangement has been made with Messrs. S. Instone & Co., Ltd., for service during the period of the Fair; the aeroplane used will be the famous "Vimy" Rolls-Royce Twin Engine Limousine Type de Luxe, similar to the machine that flew the Atlantic. The seating capacity is for 15 passengers, and the journey will take under an hour. The pilot will be one of those who were engaged on the London and Paris Peace Conference air mail service. Full particulars can be obtained from the General Manager, British Industries Fair, 95, New Street, Birmingham.

War Office and Costings Clause in Contracts.—At the meeting of the Executive Committee of the F.B.I., on February 9th, Mr. Stuart A. Russell made a statement which will be read with interest by members concerning the War Office attitude towards the costings clause in tenders. While other Government Departments have agreed to eliminate this clause, the War Office has hitherto held out for its inclusion. Mr. Russell announced that in the rubber manufacturing trade all contractors had agreed to strike out this clause from their tenders, and that the War Office had accepted the situation.—*Bulletin of the F.B.I.*

Fire at Vickers's Works.—The *Sheffield Independent* states that a fire broke out in the electric welding department of Messrs. Vickers's Brightside Works, Sheffield, on February 12th. The welding shop was entirely burnt out, the hardening shop was damaged, and a 4-ton electric vehicle was also seriously damaged. The cost of the damage is estimated to be about £3,000.

Progress of Peel-Conner Works.—Considerable progress is being made with the Peel-Conner telephone works at Coventry, designed for the employment of 2,000 hands. The premises are laid out for the production of the whole range of apparatus required in the telephone industry, from a complete exchange to a small domestic set. The company is also engaging in the making of ebonite and preparing it for various uses.

Trade Conditions in Australasia.—Current trade in Victoria is on a fair scale, despite the shipping dispute. Leather prices are irregular. Trade in general merchandise in Sydney is less depressed, and greater confidence prevails. There are indications that in some cases the bed-rock has been reached. In South Australia trade is steady, but recent heavy arrivals of long-standing orders are restricting speculation. A review of business conditions in Queensland during January shows that trade has been up to the average, with a general decrease in prices. Trade in hardware is dull. There is every indication that the sugar-cane harvest will be excellent. Trade conditions in New Zealand are very fair, and demand on the part of consumers is keen.—*Reuter's Trade Service* (Melbourne).

The Situation in Germany.—The general report on the industrial and economic situation in Germany in December, 1920, recently issued by the Department of Overseas Trade, was sold out within a few days of publication. A further edition has been printed, and the report (Cmd. 1,114) can be obtained, price 9d. (post free 10½d.) on application to the branches of H.M. Stationery Office.

Coal Prices in the London Area.—The Board of Trade has approved a scheme submitted by the London Coal Committee for maximum retail prices of coal and coke in the London area, which will be published as soon as possible. The scheme follows very closely the general lines of the Household Fuel and Lighting Order, 1918.

The Electric Vehicle Committee.—The accounts of the Electric Vehicle Committee of Great Britain for the year ended March 31st last, show an income of £1,996, as against £888 in the previous year. Expenditure, however, increased in greater proportion, having been £1,978, compared with £778. The surplus was thus £18—a large fall from the 1918-19 figure of £110. The excess of assets over liabilities shown by the balance-sheet is £149.

Irish Railway Electricians' Wages.—An Industrial Court having heard an application by the Electrical Trades Union on behalf of the train lighting staff, arc lamp trimmers, and wiremen's helpers employed by the Great Northern Railway of Ireland at Dublin, Belfast, and Dundalk, for payment of wages rates prevailing in the respective districts, and for re-grading of carriage men, decided that the weekly hour rates for the three grades should be increased to:—Grade 1, 38s.; grade 2, 35s.; grade 3, 30s.; these rates to be subject to the addition of war advances of 33s. 6d a week and the bonus of 12½ per cent. on earnings. The decision takes effect as from September 3rd, 1920. The claim for district rates was ruled out.

A Committee on Patents.—The Lord President of the Council has established an Inter-Departmental Committee on Patents, with the following terms of reference:—

1. To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged as research workers, or in some other technical capacity, so as to give a fair reward to the inventor, and thus encourage further effort to secure the utilisation in industry of suitable inventions, and to protect the national interest.

2. To outline a course of procedure in respect of inventions arising out of State-aided or supported work, which shall further these aims, and be suitable for adoption by all Government Departments concerned.

As at present constituted, the Committee consists of the following members:—

Mr. Kenneth Lee, LL.D. (chairman); Mr. W. St. D. Jenkins, C.B.E., Admiralty, Director of Contracts; Mr. F. E. Smith, O.B.E., F.R.S., Admiralty, Director of Scientific Research; Air Vice-Marshal Sir E. L. Ellington, K.C.B., C.M.G., C.B.E., Air Ministry, Director-General of Supply and Research; Mr. H. W. W. McAnally, C.B., Air Ministry, Assistant Secretary; Mr. P. W. L. Ashley, C.B., Board of Trade, Assistant Secretary, Industries and Manufactures Department; Colonel W. H. D. Clark, O.B.E., Board of Trade, Assistant Comptroller of the Patent Office; Sir H. Frank Heath, K.C.B., Department of Scientific and Industrial Research, Secretary; Mr. A. J. Stubbs, M.Inst.C.E., M.I.E.E., General Post Office, Assistant Engineer-in-Chief; Mr. H. H. Dale, C.B.E., M.D., F.R.S., Medical Research Council, Head of Department of Biochemistry and Pharmacology; Mr. W. J. Coombs, Ministry of Munitions; Lieut-Col. P. K. Lewes, C.M.G., D.S.O., R.A., War Office, Assistant Director of Artillery; Mr. P. Tindal Robertson, Barrister-at-Law, Royal Commission on Awards to Inventors, Secretary; Sir R. A. Gregory, F.R.A.S., Editor of *Nature*; Mr. D. M. Kerly, K.C., and the Hon. Sir Charles A. Parsons, K.C.B., LL.D., D.Sc., F.R.S.

The Secretary to the Committee is Mr. A. Abbott, to whom all communications should be addressed at 16 and 18, Old Queen Street, Westminster, London, S.W. 1.

Costing.—The following are the March arrangements of the Institute of Cost and Works Accountants' lectures to be held in the Hall of the Institute of Chartered Patent Agents, Staple Inn, at 7 p.m.:—March 2nd, "Some Deviations in Costing Principles," by R. J. H. Ryall; March 9th, "Economics in Relation to Costing," by Wilfred Grainger; March 16th, "Some Observations on the Proposed Amendments of the Workmen's Compensation Act 1906," by H. G. Simmons.

New Devices.—We understand that the "Utility" electrical current limiter, the "Turner-Schattner" selenium cell automatic street lighting device, and some novel cooking apparatus which MESSRS. ELECTRICAL AND ENGINEERING DEVELOPMENT, LTD., have developed in the course of the last 12 months, will shortly be placed on the market.

The E.P.E.A. Award.—The Stockton Electricity Committee reported, at a special meeting of the Town Council, on February 15th, the latest developments with regard to the dispute with the E.P.E.A., and recommended that, under the whole circumstances existing nationally, the conditions and schedule, as issued, should be adopted. The recommendation was agreed to.

The threatened strike of the engineers at the Keighley power station has been averted, as a conference between the Special Committee appointed by the Town Council and Mr. W. A. Jones, general secretary of the E.P.E.A., resulted in the Committee agreeing to pay the men concerned in the dispute salaries in accordance with Scale C of the Schedule, and, in the meantime, appeal is to be made to the District Joint Board on the question of the grading of the Keighley power station.

Calendar.—MESSRS. BRITISH ELECTRICAL REPAIRS, LTD., of 44, Fennel Street, Manchester, have issued a wall calendar with a block of daily date slips beneath a photographic reproduction of an armature badly in need of the services that they are able to render.

Social Events.—The third social evening of the staff and friends of the Ediswan Electric Co., Ltd., at Bristol, was held in the company's show-room there, on 2nd inst. The district manager, Mr. Fifield, presided over a company of about 70. A varied programme of music, &c., was provided, the "Ediswan Jazz Party" being one of the "star turns" of the evening. Votes of thanks were accorded to the chairman, artists, and organisers, for their efforts in connection with these friendly gatherings.

On February 19th the town and country members of the staff of Messrs. Drake & Gorham, Ltd., and Messrs. Drake & Gorham Wholesale, Ltd., were entertained at luncheon by the chairman and directors, at the Connaught Rooms. The company numbered some 250, and Mr. Bernard M. Drake presided. After an excellent luncheon, followed by the toast of "The King," Mr. Drake delivered an impressive address with reference to the critical times through which the country was passing. He held that the future depended upon loyalty and the suppression of Bolshevism, with all that it implied. The cost of the war could only be paid by hard work on the part of everyone; but since the armistice a spirit of self-seeking had pervaded the whole country. There had been no fewer than 300 strikes—but not only the workpeople, but also shopkeepers and employers had been to blame. Prices had been forced up to such a ridiculous pitch that orders were now scarce, and electric lighting was too dear, with the result that unemployment was rife. The "Ca' canny" policy meant taking money that had not been earned; it led to loss of employment, and could not go on. They were up against the hard realities of supply and demand, and foreign competition. Doles to men out of work had to be paid by those who were in work, and the result was excessive taxation. Capital and Labour—both manual and mental—were all dependent upon one another. Since he started the business 40 years ago (D. & G. was now 35 years old) he and his colleagues had put the profits into the business; the brain-worker had worked well since the armistice, better than the manual worker. Bolshevism was a mischievous propaganda inspired from abroad, and it was the duty of every one of them to stop it—not to leave that duty to the Government. If employers had always treated their men well, and admitted them to a share in the profits, the Trade Unions would never have come into existence. Now they had the whip hand—it was to be hoped they would get good leaders. The success of the Ford factory was due to the use of machines, which enabled the firm to pay high wages and employ 15,000 men, none of whom received less than £1 a day (pre-war). The power used per man in America and Germany was 3 h.p.—in England only 1 h.p.; they must make greater use of machines, to secure good wages and cheap products. The studious man was not allowed to earn more than the slacker, whom he was carrying on his back; there should be an inducement to every man to improve his position. Payment by results was essential, and must come about. He appealed to the manual workers to adopt broad views, and put their backs into their work; then they would achieve success, and better times would come, and come quickly. The whole world was looking to England for a lead; let them show a good example.

Mr. R. W. Smith expressed his agreement with the chairman, and proposed the health of Mr. Drake, his son, and the directors, which was drunk with musical honours. An excellent concert followed, which was greatly appreciated.

Cast-Iron and Allied Industries Research Association.—The Research Association for the Cast-Iron and Allied Industries has been approved by the Department of Scientific and Industrial Research. The secretary of the Committee engaged in the establishment of this association is Mr. Thomas Vickers, 174, Corporation Street, Birmingham.

Japanese Lamp Exports.—Japan's output of electric lamps this year is estimated at 14,000,000. Their sale is increasing in India, China, and the islands to the south of Asia.—*Indian Textile Journal.*

Book Notices.—"Collected Researches of the National Physical Laboratory." Vol. XV. 1920. Pp. 329. London: H.M. Stationery Office. Price 20s. net.—Eighteen papers are included in this volume. Half of these are metallurgical in character, dealing with metallic structures, pyrometry, &c. Other papers are "On the Measurement of Small Inductances and on Power Losses in Condensers," "Note on the Measurement of the Peak Potential of an Alternating Source," "Experiments on the High-Tension Magneto," "Notes on the 'Break' of a Magneto or Induction Coil," and two papers on radioactive luminous compounds.

A special issue of *Nature* for February 17th is mainly devoted to articles on the principle of Relativity, a subject which is foremost in the minds of physicists to-day. Following on the Michelson-Morley experiment, and the deductions of Fitzgerald, Larmor, and Lorentz, indicating that no experiments could ever reveal absolute motion through the ether, Einstein showed that on this basis remarkable consequences as to time and space resulted, and the sensational support given to his theory by the British solar eclipse expedition of 1919 brought the matter into the forefront. In the special number some 14 articles on various aspects of the theory by leading authorities appear, together with a bibliography of the subject, making the issue one of permanent value.

"The *Journal* of the South African Institution of Engineers." Vol. XIX. No. 6. January, 1921.—This issue contains an illustrated paper on "Rubber Manufacture in South Africa," together with a subsequent discussion.

"The Practical Electrician's Pocket-Book," 1921. Edited by H. T. Crewe, M.I.Mech.E. Pp. lxxii + 530 + diary. London: S. Rentell & Co. Price 3s. net.—The edition for 1921 has been enlarged by several pages, of which a certain number have been absorbed by the growth of the central stations in the United Kingdom. The section on wiring has been most carefully revised and extended, in order to bring it in line with the latest developments in conduit practice, as set down by the I.E.E. Rules, while Mr. Raymond J. Mitchell has rewritten the chapter on accumulator road traction, which is undoubtedly growing very rapidly in favour in the United Kingdom. An entirely new section has been devoted to an illustrated description of the Pulsynetic system of electric clocks, and the chapter on electric welding has been revised, so as to include a practical description of the "Quasi-Arc" process, which is being used so largely in the shipyards and engineering works on the Clyde, Tyne, Mersey, &c.

"Wireless Telegraphy." By B. Leggett. Pp. xvi + 486; 230 figs. London: Chapman & Hall. Price 30s. net.

"Science Abstracts." A and B. Vol. XXIV. Part I. Jan. 31st, 1921. No. 277. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each part.

Lantern Slides on "Wireless."—We are informed that Messrs. Newton & Co., Ltd., have recently prepared a set of lantern slides for a lecture on "Wireless Telegraphy," dealing more particularly with the Elwell-Poulsen system. They are accompanied by a full set of notes, which provide alternative methods of treatment for audiences of varying degrees of acquaintance with the subject. Many of the slides are from hitherto unpublished photographs. Messrs. Newton's address is 37, King Street, Covent Garden, W.C. 2, and a small charge is made for the hire of the set.

LIGHTING AND POWER NOTES.

Bromley (Kent).—Prices.—The Ministry of Transport has informed the Town Council that, at the request of the Electric Light and Power Co., Ltd., the temporary increases of charges order has been revoked, and that the company has given an undertaking not to enforce, without previous sanction of the Ministry, a higher minimum charge per quarter to consumers than 12s. 6d. for any amount up to 15 units for each of the quarters ending March 31st and December 31st, and 8s. 4d. for any amount up to 10 units for the other quarters of the year.

Continental.—Italy.—The hydrographic service in Italy dates no further back than 1917, when it was called into being by the Consiglio Superiore delle Acque (Water Board) on the lines suggested by Prof. Fantoli. Italy is now divided into eight sections—namely, Pisa, Rome, Naples, Catanzara, Chieti, Bologna, Cagliari, Palermo—each section allotted to separate river systems. The rainfall is measured at stations, the number of which has risen since 1918 from 371 to 1,300; the flow of the rivers is measured either at the rainfall stations or at special stations, of which 300 new ones are scheduled; data are also compiled of the state of mountain lakes and artificial reservoirs, as well as statistics of electrical energy, based on the daily reports of each company.

Four rivers of the Trentino, says *l'Elettricista*, could supply the Adige and Brenta each with half a million horse-power, which would equal the power generated by two million and a-half tons of coal, costing a milliard lire each year.

Trentro is building a second large central station, Rovereto is enlarging its own, a big trust has been embodied to utilise the water power of the Giudicarie, and a private company is to harness the Avisio. With these undertakings the electrification of the Brenner line becomes assured.

East Ham.—Installation Costs.—A statement in one of our lay contemporaries that electricity was being installed in new houses at Ilford at a cost of £85 per dwelling led us to make inquiries into the truth of the matter. We are informed that for the 16 houses erected by the Council the cost of the electrical installation was £12 1s. per house, while for a further 20 houses the figure has been reduced to £10 10s. The decision to install electricity was arrived at after due consideration of estimates submitted by the gas company.

Electricity District.—Mersey and West Lancashire District.—The Electricity Commissioners have definitely arranged to resume the adjourned inquiry at Liverpool on Tuesday, March 8th, and the following days.

Eston.—Electric Light Order Approved.—The Council's Electric Lighting Order having been passed by the Commissioners, the Clerk has been instructed to approach the Cleveland and South Durham Power Co. and Messrs. Bolckow, Vaughan and Co., Ltd., for their terms for a bulk supply.

Finchley.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £53,650 by the Council for the extension of the electricity undertaking.

Galashiels.—Proposed Price Increase.—The Electricity Supply Co., Ltd., has applied for an order to increase the price of electricity for power from 3d. and 2d. per unit to 5d. and 2½d.; and for lighting from 10s. up to 20 units and 6d. beyond to 15s. and 9d.

Greenock.—Supply to Cotton Mill.—Messrs. J. & P. Coates, Paisley, have applied to the Corporation Electricity Committee for a supply of electricity to their Ferguslie Mill. Mr. Whysall,

the burgh electrical engineer, has been instructed to submit a scale of charges proposed to be made, and correspondence is being carried on between the Paisley firm and the Corporation.—*Glasgow Herald.*

Ipswich.—New Plant.—A new rotary converter is to be installed at the Duke Street sub-station, at an estimated cost of £5,400.

Lochaber Water-power Scheme.—Application for Order.—A petition has been presented to the Secretary of State for Scotland for the grant of a provisional order incorporating a company under the name of "The Lochaber Power Co." The general purposes of the company are stated to be to provide and supply water, hydraulic and motive power, and to generate and supply electricity. The share capital of the company is proposed to be £3,000,000. Power is also to be sought to empower the company to subscribe for shares in other undertakings which the directors "may consider advantageous to the company." The works proposed to be constructed by the company are all within the County of Inverness, and comprise, mainly, the construction of dams for upholding the waters of the rivers Spean and Treig, and of Loch Treigh and Idir Loch. Other works include a deviation of the West Highland Railway, of the North British Railway for a distance of over 1¼ miles, and the impounding of the waters of the rivers Spey and Mashie, and the waters of Loch Laggan and numerous streams.—*Financier.*

London.—Greenwich.—The London County Council has prepared a scheme for increasing the plant at the Greenwich generating station at a cost, says *The Times*, of £400,000.

Electricity District Inquiry.—The Electricity Commissioners have provisionally fixed Tuesday, June 7th, 1921, as the opening date for the local inquiry which is to be held in connection with the schemes which have been submitted for reorganising the supply of electricity in the provisionally delimited London and Home Counties Electricity District.

Luton.—Price Reduction.—Owing to the efficiency of the new plant resulting in a substantial profit, the Electricity Committee recently recommended that all charges for electricity should be reduced 25 per cent. The recommendation was adopted by the Council, and the new charges will take effect after the March meter readings. The rates will be still double the pre-war charges.

Mesopotamia.—Baghdad Lighting Profit.—*The Times* states that the latest information from Baghdad indicates that the electrical section (military) is extremely efficient. The energy is produced cheaply, and watt-hour meters are preferred by some consumers as being cheaper than the fixed-price system in general vogue. The undertaking is working at a profit.

New Brunswick.—Water-power Development.—The water powers at Musquash, N.B., are being developed by a commission appointed for the purpose. The work will cost approximately £250,000. The commission generates the electricity, and supplies it at cost to the municipality. The distribution is left to the latter body, which can either handle the power direct, after erecting its own distribution system, or sell it to an existing company, safeguarding the community as to the rates to be charged. In the case of St. John, where the New Brunswick Power Co. operates the tramway and lighting and power system, it will have to be decided whether that company using steam shall receive the power or meet the competition of the municipality with hydro-electric power.—*The Times.*

Newfoundland.—Suspension of Services.—A series of blizzards culminated in a storm which crippled the electric service, thus depriving the city of light for a week, and caused a suspension of the railway, steamship, and tramway services, isolating every section of the country. The conditions prevailing have been the worst for 30 years. Snowdrifts as high as 20 ft. have lain on the ground for several days. No express trains have arrived or left St. John's for 10 days, and it will probably be another week before connections are resumed.—*Reuter.*

Peterborough.—Electricity for New Houses.—In a recent Town Council discussion, a speaker pointed out that the cost of electricity was not the only thing to be considered when deciding upon the lighting of the new houses at Paston Lane. Utility and cleanliness were important factors. It was decided finally to install electricity for lighting and gas for cooking.

Perth.—New Plant.—On the recommendation of the Electricity Committee, the Corporation has agreed to install a 1,000-kW d.c. set and an additional boiler at the Corporation electricity works, at an estimated cost of £50,000. The extension is to be proceeded with at once.

Preston.—Purchase of Undertaking.—It is announced that the Corporation has entered into a provisional agreement to purchase the National Electric Supply Co., the money to be met partly by mortgage bonds. Three directors are to receive £8,400 for loss of office, and the officials' position is also to be considered. The bonds will bear interest at the rate of 6 per cent., but a definite sum has not been fixed for the purchase. The annual report of the company shows expenditure on capital account for the year of £35,340, including the acquisition of a valuable site on the riverside and the purchase of a third turbo-generator. With a balance from last year the gross profit was £21,689; it is recommended to place £5,000 to depreciation and £3,000 to reserve; to pay 4 per cent. on preference shares and 2s. 6d. on ordinary shares for the half-year ending June 30th, and 6s. 6d. per share for the second half-year, making 9s. per share for the year; to pay a dividend of £5 8s. 6d. on each of the founders' shares of the company, and to carry forward £1,366.

Swansea.—Change of Supply System.—The borough electrical engineer considers that the Uplands area should be changed over from a d.c. to an a.c. supply, and, if this were to be done, it would mean that the whole of the motors would have to be changed, together with the meters, the total cost being approximately £6,000; but, as he will be able to utilise the present motors and meters (which he values at £6,200) for other purposes, the actual change-over can be effected without cost. Regarding the Morriston supply, he reports that the present cable is practically running at its maximum capacity, and, in order to be able to give a full supply next winter, he recommends that the e.h.p. main, which is at present being laid as far as the Lower Forest Foundry, be extended to Wychtree Bridge, where a sub station should be erected, the cost of the alteration being approximately £6,000. The Electricity Committee approved the recommendation of the report, and asked the electrical engineer to report on the question of distribution in other parts of the borough.

Electricians' Wages.—The Secretary of the Amalgamated Engineers' Union has written expressing inability to accept the decision of the Council with regard to the wages of the skilled men at the Corporation electricity station, and asking that the wage of the £5 16s. per week be assured to the men whether the ultimate award of the National Joint Council be lower or not. The Council has resolved to adhere to its previous decision.

Extension of Supply Area.—The Corporation has under consideration a scheme involving an expenditure of £40,000 to extend the Corporation electricity supply to the large and growing area of the Amman Valley, and a special meeting of the Council is to consider the details. Several important works and collieries are seeking electric power and light; Ammanford, Gowerton, Gorseinon, and Pontardulais, important industrial areas, come within the scope of the scheme, which, according to the chairman of the Electricity Committee, Alderman Sinclair, has enormous possibilities, apart from the fact that a return of £5,000 per annum is assured from the start.

Tasmania.—Hydro-Electric Developments.—It is reported from Hobart that with the arrival of heavy machinery from England and America, the extensions in connection with the State Hydro-Electric Department's works are being rapidly pushed forward, and it is anticipated that the present connected load of 17,000 h.p. will be increased to 57,000 h.p. in a little over a year. The work connected with the raising of the existing dam at the outlet of Arthur's Lakes by over 18 in. has been completed, and the level of the lake is now slowly rising. Various improvements have already been made to Hobart port, and a report is being made on the cost of a new 25-ton electrically-driven crane to meet modern requirements, a new crane being necessary to cope with the big shipments of heavy machinery which are to follow.—*Reuter's Trade Service* (Melbourne).

The Grampian Scheme.—Competition with Municipalities.—In an interview with a correspondent of the *Dundee Advertiser*, Major J. S. Barnes, of the Hydro-Electric Development Co., Ltd., the promoter of the Grampian Scheme, stated that it was not intended to compete with the municipalities in the supply of electricity. Nevertheless, if a settlement was not arrived at, the company was under no obligation to refrain from introducing supply into the territory at present served by the Dundee Corporation, and would naturally be ready to discuss proposals for the supply of power to consumers within the area.

TRAMWAY AND RAILWAY NOTES.

Argentina.—Strike Ended.—The Rosario municipal workers and tramway drivers have, says *The Times*, returned to work.

Australia.—New "Tube" System.—The Sydney *Sun* recently gave full details of the new partly underground railway system for which excavations are proceeding. The present Central Station of the New South Wales Railway system is in an inconvenient position, and the new city railway is designed to convey passengers to the centre of the city, the water front and the suburbs. The new railway will be below ground for about 2·5 miles, and its total length will be about 5·1 miles. There are to be six stations each with a platform 520 ft. in length. The new Central Station will be above ground; four island platforms are to be provided giving the station a capacity of 210 trains per hour. Where the line runs underground practically the whole of the tunnelling is through hard sandstone; the tunnels will be lined with brick and concrete, and steel frame construction will only be used at certain points. The work was commenced in 1916, but in June, 1918, had to be stopped owing to the difficulty of obtaining plant and materials. The original estimate of the cost was £3,750,000, but this will probably be £8,000,000, owing to the large increases in all charges.

Birmingham.—Proposed Railless Cars.—The Tramways Committee has received the report of the Committee which has been studying the railless car system of Bradford with a view to applying the system to Birmingham. The report is a very

favourable one, and it is considered that railless cars will be most suitable for a number of routes where the traffic is comparatively light. It is hoped to have an experimental route from the centre of the city to a suburb open within a year. A considerable amount of new track is being laid in various parts of the city. This work is estimated to cost about £70,000.

Continental. — France. — Omnibus and tramway-car tokens of 25 and 50 centimes value (nominally 2½d. and 5d.) have made their appearance in Paris. The tokens are good for payment only in tramway-cars, in the Underground trains, and in the motor-omnibuses.—*Daily Mail.*

India.—Electric Vehicles to be Introduced.—Mr. F. L. Milne, the municipal electrical engineer, Punjab, while on home leave last year, was deputed to go into the question of adapting electric vehicles to conditions of running on the Simla roads. On his return he made his recommendations and, as a result, the municipality has now decided to order the chassis of a one-ton electric lorry which will be equipped with a 'bus body suited for carrying about 12 passengers, to be run between Simla and Mashobra as an experiment. Should the venture prove a success, as anticipated, electric vehicles for running in and about Simla will, it may be taken for granted, be introduced on a considerable scale.—*Indian Textile Journal.*

Calcutta Strike. — A party of armed European police that had been sent to quell the rioting of the tramway employés, who have been on strike for three weeks, was attacked by the mob last week, says the *Daily Mail*; the police opened fire, and after one rioter had been killed, and two injured, the mob dispersed.

Ipswich.—Additional Loan.—The Town Council finds it necessary to amend its original application for sanction to a loan of £4,000, to defray the cost of a building for the electric vehicles, by the addition of a further £1,000. Two hangars were purchased from the Disposal Board, and these were put together to form one large shed covering an area of 6,900 sq. ft.

Liverpool.—Minimum Fare.—A minimum fare of 2d. on the tramways of the Corporation came into operation on the 21st inst.

London, Brighton, and South Coast Railway.—At the annual meeting on Wednesday, last week, the chairman, Mr. C. C. Macrae, in the course of his remarks, said :—The directors were very anxious to get on with the scheme for the electrical equipment of the suburban railways, and, as the late chairman stated last year, the Government had been approached with a view to authority being given for the work to proceed, but up to the present they had not succeeded in carrying the matter much farther. This was to be regretted, as in the directors' opinion the extension of electrical working would have a very beneficial effect upon the company's business.

London.—Proposed New "Tube."—The City and South London Railway Co. recently received from the Wandsworth Borough Council a suggestion that extensions should be constructed from Clapham Common to Southfields (*via* Wandsworth) and to Tooting. The company states that the present time is not favourable for the execution of such extensions, and more urgent work has to be proceeded with, including the enlargement of tunnels and the improvement of the existing lines.

Trailer Cars.—The Minister of Transport has intimated that he approves of the use of passenger trailer cars at any time on 22 tramway routes in the L.C.C. area, in addition to those on which they are at present used.—*The Times.*

Combined Tramway and 'Bus Routes.—Through tramway and omnibus tickets, *via* Victoria Station, came into operation on February 16th, under an agreement between the Highways Committee of the London County Council and the London General Omnibus Co. The scheme provides for both the Council and the company to issue through tickets, *via* Victoria, at fares of 2d., 3d., 4d. and 5d., based on the addition of 1d. to the tramway fares of 1d. 2d., 3d. and 4d., from Victoria, the company to convey through passengers by any omnibus for a 1½d. stage from Victoria. Certain of the omnibuses will be diverted from Victoria Station-yard so as to facilitate the interchange of passengers, and early morning omnibuses will be provided to connect with the Council's workmen's cars. Through tickets, however, will not be issued in connection with either workmen's fares or the 2d. mid-day fare.—*The Times.*

Northampton.—Loss in Working.—Northampton Corporation tramways show a loss estimated at £8,900 during the current financial year ending March 31st, but the expenditure includes £9,300 for relaying the track.—*Manchester Guardian.*

Oxford. — Opposition to Company's Bill. — The Council has decided to petition against the Parliamentary Bill being promoted by the City of Oxford Electric Tramways, Ltd., by which the company seeks an extension of its powers.

Portsmouth. — Reduced Services. — The municipal tramways began working short time, and with a reduced service on February 21st, says *The Times*. This step has been taken because the system is being worked at a loss.

Tramway Inquiry.—Position of Industry.—At the tramway wage inquiry on February 17th. Mr J. B. Hamilton, of Leeds, stated that for the industry as a whole the actual revenue at present fell short of the approximate expenditure by 3·55d. for every car-mile run, a deficiency amounting to 3s. 2½d. for every £1 of traffic receipts. If the wage increase claimed were added to the present approximate expenditure the corresponding figures would be 5·14d. and 4s. 8d. The industry had been carried on at a dead loss of at least £1,555,859 during the last financial year. For 1920-1921 it would be approximately £3,310,000 on the same mileage; with the additional charge for wages now asked the loss would be approximately £4,793,000.—*The Times.*

Wigan.—Fare Increase.—The Corporation is revising tramway fares, as it is estimated that there will be a deficit of £15,000 on the present year's operations. Alterations, reconstruction of rolling stock, and other expenditure, which has been paid out of revenue, total over £6,000, so that the deficit is not actually so large as it seems.

TELEGRAPH AND TELEPHONE NOTES.

Australia. — Wireless Telegraphy.— Arrangements are being made by the Postmaster-General's Department for the establishment of wireless stations at Camoweal, near the Queensland border, and Powell's Creek, in the Northern Territory. The scheme for which approval has been given, is the first step in linking up the outposts with the centres of business of the Commonwealth. The initial cost will be in the vicinity of £4,000. It is also hoped that private persons will be encouraged to adopt wireless telegraphy and negotiations are already in process with that view. The idea of the department is that the stations at Camoweal and Powell's Creek will act as collecting offices for private plant. In other words, they will be the central exchanges through which business will be conducted. Full rates will be charged for all messages received from and dispatched to private plant. These will be somewhat higher than telephone or telegraph rates.—*Reuter's Trade Service* (Melbourne).

China.—Wireless Station Contract Cancelled.—With regard to the Chinese Government having signed a contract with the American Federal Telegraph Co. for the erection of a high-powered wireless station at Shanghai, and the protests thereto which followed from the Marconi Co. and the British Government representatives, *Reuter's Trade Service* reports from New York that the *World's* Washington correspondent says that the State Department has notified China that the U.S. Government will regard as an unfriendly act China's cancellation of the contract with the American Federal Telegraph Co., and adds that the State Department has communicated with the British Foreign Office on the subject. *The Times* says that Denmark and Japan also protested, and the British Government is understood to back the Marconi Co.'s claim, while America supports the U.S. Co. on the ground that the Marconi Co.'s franchise is a monopoly, and as such not only contrary to its communications policy, but also out of harmony with the policy of the "open door" in China.

China has accepted the invitation to participate in the next International Wireless Convention.—*Reuter's Trade Service* (Peking).

Germany.—Wireless Telegraphy.—According to the Swiss *Elektro-Industrie*, the German wireless services are of three kinds—the international, the home, and the special. The stations at Nauen and Eilvese afford communication with overseas countries, and that at König-Westerhaus with European countries. The home service is catered for by 15 stations, besides 15 coastal stations for communication with shipping. The Nauen station has lately undergone considerable modifications, with a view to facilitate the service with America. At present duplex communication has been set up between Nauen and the Marconi station at Marion, and transmission is made simultaneously in the two directions. The Marion messages are not received at Nauen itself, but at Geltow, near Potsdam, and 10,000 words per day are sent, but this number might be fourfolded. Nauen is able to transmit 24,000 words per day. The transmission plant consists of two high frequency machines, each of a capacity of 500 kW, and a smaller 200-kW machine, with corresponding transformers. There are two antennæ entirely distinct. It is in contemplation to double the plant, with the object of providing a separate service to South America.

India.—Bombay Strike Ended.—The strike of the postal and telegraph peons (messengers) has come to an end, says *The Times*, after having lasted close upon five months.

Telephone Service. — New Inquiry. — Sir Gordon Hewart, the Attorney-General, announced in the House of Commons, on February 18th, that the Government had consented to set up a select committee to inquire into the "administration and the organisation of the telephone service," and that the "method of making charges" should also be investigated, but stipulated that the new rates must come into force on April 1st. He read a typical letter to show what it was that was complained of. "Hear, hear!" cried members, as they heard the familiar phrases about wrong numbers and numbers reported as "engaged" when that was not the fact. "Yes," said the Attorney-General genially, "but the letter is dated January, 1907, and was addressed to the old National Telephone Co." He would not concede the flat-rate system, and said that it would be administratively impossible to make any repayments if the Select Committee reported against the new charges. But on Wednesday Mr. Bonar Law had said that if by any chance the House disagreed with the decision of the

Government, a rebate would be given. That is a difference of opinion which, no doubt, will call for further explanation in the House.

WAGE BILL.—In the House of Commons, on Feb. 21st, Mr. Illingworth (Postmaster-General), replying to a question, stated that the total number of officers in the employment of the National Telephone Co. at the time the undertaking was transferred to the Post Office was about 19 650, and the company's annual wage bill amounted to £1,243,000. The average number of Post Office servants employed in the telephone service in the financial year 1919-20 was approximately 44,500, and the total amount paid to those officers was £7,300,000, including war bonus. The figures relating to the Post Office included the staff employed on services—*e.g.*, the trunk service—which were not controlled by the company.

U.S.A.—COMBINED WIRE AND WIRELESS TELEPHONY.—A telephone conversation between a ship in the Atlantic and Catalina Island (30 miles south of Los Angeles), in the Pacific, has been accomplished by a combination of wireless and overland wire communication by the American Telegraph and Telephone Co. Calls were also relayed across the American continent to New York and other cities.

INTERNATIONAL COMMUNICATIONS CONFERENCE.—The Conference, which resumed sittings at Washington on February 11th, is again unable to reach an agreement on the subject of the disposal of the former German cables. Dispatches from Washington state that the deadlock is as complete as that which caused the break-up of the Conference several weeks ago, and the *New York Times* states that there is reason to believe that the United States Government has intimated to the Conference that it reserves the right to take such measures for its national interests as conditions may require if an agreement is not reached before March 15th, which is the date of the expiry of the *modus vivendi* established at the last meeting of the Conference.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (February 11th.)

Australia.—MELBOURNE.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

April 19th. P.M.G. Telephone switchboards (Schedule No. 1,670). Specifications may be seen at Department of Overseas Trade (Room 59), in London.

April 19th. P.M.G.'s Department. Switchboards, schedule 1,670. (See this issue.)

April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33.914). Specification may be seen at Department of Overseas Trade (Room 59), in London.

BRISBANE.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast. — Tramways Committee. Two 500-kW, 500/550-V converters. (February 18th.)

Belgium.—ANTWERP.—March 1st. Supply and erection of an electric motor pump group at No. 7 dry dock of the Lefebre basin at Antwerp. Particulars from the Direction Générale du Port d'Anvers.

March 2nd. Belgian Ministry of National Defense. Supply of 109 kilometres of telephone cable. Tenders are to be sent to the 3e Direction Générale du Ministere de la Defense Nationale, 10, Rue du Meridien, Brussels, whence particulars may be obtained.

Croydon.—March 7th. Electricity Department. Two natural draught cooling towers. (February 18th.)

Dumfries.—March 2nd. Education Authority. Electric lighting installation at Woodbank Hostel. Mr. W. Arnott, 163, Hope Street, Glasgow.

Holland.—Fixed electric revolving crane for the quay at the Waterworks, Oude Plantage of Rotterdam; 2,500 kilos. lifting capacity; radius, 7 metres; 400-V supply available. Mr. A. Van Delden, Acting Manager of the Municipal Waterworks. Rotterdam (mention H.M. Consul-General as source of information).

Leeds.—March 8th. Electrical work required in the Education Committee's schools for the year ending March 31st, 1922. Architect, Education Department, Calverley Street.

London.—H.M. Office of Works. March 2nd. Six or twelve months' supply of electric lamps. (February 18th.)

CAMBERWELL.—February 28th. Libraries Committee. Installing electric light, &c., in the Central Library, Peckham Road, S.E. (February 18th.)

Macclesfield.—March 14th. Cheshire County Asylum, Parkside. Stores, including electrical goods, for six months. W. G. F. Tingay, Clerk.

Manchester.—April 4th. Electricity Committee. 33,000 and 6,600-V switchgear, induction regulators, &c., for controlling sub-stations of large capacity. (February 18th.)

New Zealand. — WELLINGTON. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Portsmouth.—Electricity Supply Department. Three 1,500-kVA Scott-connected transformer groups, 3-phase, 6,600-V switchgear. (February 11th.)

Rhondda.—April 5th. Electricity Department. A.c. house service meters, cable, joint boxes, &c. (See this issue.)

South Africa. — PRETORIA.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (February 11th.)

Stockton-on-Tees. — February 28th. District Fund. Gas and Electricity Committees. Articles and stores for six months. (February 18th.)

March 9th. Electricity Department. A.c. 1 p. switchgear. (See this issue.)

Uruguay.—MONTE VIDEO.—March 29th. State Power House. Single and three-phase meters.*

March 31st. A telegram from H.M. Minister at Monte Video (Sir C. C. Mallet, C.M.G.), to the Department of Overseas Trade, states that general tenders are invited until March 31st for the construction of the projected port works at Paysandu, for which an expenditure of $280,457.30 has been sanctioned. The construction of a dyke, the acquisition of electrical handling and lifting apparatus, the extension of the mole and the construction of anchoring grounds, are included in the scheme.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

London.—BATTERSEA.—Electricity Undertaking Committee. Accepted:—

Pipework in connection with the plant extension.

Alton & Co., Ltd., £1,404; Babcock & Wilcox, Ltd., £298.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, February 25th. At the Philosophical Institute. At 8 p.m. Paper on "Telephone Troubles," by Mr. J. McEwan Brown.

Electrical Trades Benevolent Institution (North-East Coast Section).—Friday, February 25th. At the Grand Assembly Rooms, Newcastle-on-Tyne. Second annual dance in aid of the funds of the Section.

Physical Society of London.—Friday, February 25th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting

Institute of Transport.—Monday, February 28th. At the Institution of Civil Engineers, Great George Street, S.W. At 5.30 p.m. Paper on "Electrification of Main Line Railways in Relation to Traffic Working," by Sir P. Nash.

Manchester Wireless Society.—Wednesday, March 2nd. At the Albion Hotel, Manchester. At 7.30 p.m. A discourse on "Workshop Hints as applied to Wireless Telegraphy," by Mr. R. Hallam.

Chelmsford Engineering Society.—Thursday, March 3rd. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Direction and Position Finding by Wireless," by L. D. Hills.

Chemical Society.—Thursday, March 3rd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Institution of Electrical Engineers.—Thursday, March 3rd. At the Hotel Cecil, Strand, W.C. At 7 for 7.30 p.m. Annual dinner and reunion.

Informal Meeting.—Monday, February 28th. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Informal social evening.

North-Eastern Centre.—Monday, February 28th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Lecture on "Thermionic Valves," by Mr. W. D. Owen.

Liverpool Sub-Centre.—Monday, February 28th. At the Liverpool University. At 7 p.m. Paper on "Temperature Limits of large Alternators," by Mr. G. A. Juhlin.

East Midland Sub-Centre.—Tuesday, March 1st. At the College, Loughborough. At 6.45 p.m. Paper on "Phase Advancers, Rotary and Static," by Mr. G. A. Pearson.

Birmingham and District Electric Club.—Friday, March 4th. At the Grand Hotel, Birmingham. At 6.45 p.m. Annual dinner.

British Electrical Development Association (Inc.).—Friday, March 4th. At the Offices of the British Electrical and Allied Manufacturers' Association, 36, Kingsway, W.C.2. At 12 noon. Adjourned first annual general meeting.

Royal Institution of Great Britain.—Friday, March 4th. At Albemarle Street, Piccadilly, W. At 9 p.m. Lecture on "Severn Crossings and Tidal Power," by Mr. W. A. Tait.

Saturday, March 5th. At 3 p.m. Lecture on "Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture I.)

Royal Society of Arts.—Friday, March 4th. At John Street, Adelphi. At 4.30 p.m. Lecture on "Brown Coals and Lignite: Their Importance to the Empire," by Prof. W. A. Bone, F.R.S.

Salford Technical and Engineering Society.—Saturday, March 5th. At the Royal Technical College. At 7 p.m. Paper on "The Barton Electric Power Station," by Mr. S. L. Pearce.

NOTES.

Electricity v. Gas for Libraries.—At a meeting of the Camberwell Borough Council, on February 16th, the lighting of the Central Library was referred to. The open-access system had been agreed to, and the question was whether the lighting would suit the altered conditions. The Public Libraries Committee reported:—"In the first place, we directed our attention to the question whether the library should continue to be illuminated by gas, or whether it would be advisable to substitute electricity, and in connection with this matter we had before us a report made by Dr. S. Rideel with regard to ventilation and the action of the acids in the gas and air upon the books in the institution. There can be no doubt that these acids have a prejudicial effect on the leather bindings of the books, and this has resulted in additional expenditure being necessary for reinstatement, and has materially affected the life of the books throughout the borough. The question of the renovation of the buildings was also considered, and we are satisfied that the cost of any works to the institution in this direction will be considerably reduced in the event of our recommendation in favour of the installation of electric light being adopted. In addition, the cost of maintenance of electric fittings, lamps, &c., will, we estimate, be less than the present outlay for maintenance of mantles, glasses, &c., and we recommend that gas be abolished, and the entire building be illuminated by electricity." The recommendation was agreed to.

Service Notes.—Lieutenant T. J. Linberry has been posted to H.M.S. *Tamar*, depôt ship at Hong-Kong, China, for charge of the wireless station at Singapore—"the Gate of the Far East." This station is one of the most important in the chain of stations which links up the Imperial route. Commander Linberry saw much service in the late war, prior to which he specialised in "wireless." Lieutenant-Commander R. W. Bayley has been appointed to H.M.S. *Jumna*, depôt ship at Bombay, India, for charge of the wireless station at Aden, Arabia. Aden is a great fortress, and like Singapore, a most important link in the wireless route round the Empire.

Fatalities.—Strong criticism of a bell system fell from Mr. S. W. Morgan (coroner), who inquired into the death of Francis Weetman, of Hightown, killed at the West Cannock Colliery, Hednesford, on February 4th. The evidence showed that Weetman was leaving the cage at the pit bottom when the cage suddenly rose, and he was crushed against the side and terribly injured. It was alleged that the electrical system of signalling installed in November last was ineffective, and the instrument sometimes did not record signals after they had been given, and it was also suggested that the bell had rung when no signal had been given. The jury returned a verdict of "Accidental death," and exonerated the engine winder from blame.—*Birmingham Post.*

While a cart was being loaded at Harrow (Metropolitan) Railway Station, on February 12th, the horse took fright and bolted across the lines. It trod on a live rail, and was killed instantly.—*The Times.*

The Engineering Golfing Society.—The report of the Committee, submitted at the annual general meeting at the Institution of Civil Engineers, on Thursday, showed a membership of 156; 50 members took part in the Spring Meeting at Coombe Hill, and 52 in the Autumn Meeting at Royal Wimbledon, the chief prize in each case being won by Mr. C. H. Hayward. Sir Alex. B. W. Kennedy is proposed as president for the ensuing year, Mr. E. W. Timmis as captain, and Mr. W. L. Mansergh as hon. secretary (5, Victoria Street, S.W. 1).

All-Electric Houses at Glasgow.—On the occasion of a visit by the members of the Glasgow Lighting Association to the Corporation showrooms, Mr. Hardie, of the Corporation electricity department, delivered an interesting address dealing with recent developments in electrical heating and cooking apparatus. While the rapid growth of the demand for electricity for illumination purposes was satisfactory, it was emphasised, he said, that to ensure a progressive reduction in prices charged for electricity, its use for purposes other than lighting should become more general. Load factor, *i.e.*, the ratio of average to maximum load, must be kept as high as possible, and the general adoption of electricity for power, heating, and cooking contributed to that end. The widespread use of electrical cookers and fires would have a material purifying effect on the atmosphere of large cities. In conclusion, Mr. Hardie referred to a forthcoming experiment in houses being built by the Corporation, which are to be fitted up as all-electric houses, and said the saving in building costs by the omission of chimneys, chimney-heads, and fire-places would be considerable.

Lifting Magnets.—The value of electric lifting magnets for handling loose metal sheets, plates, billets, &c., in iron and steel works, was discussed by Major F. A. Hooper, at a meeting of the Staffordshire Iron and Steel Institute, on February 18th. The lifting magnet, he said, made it possible to operate cranes at their maximum speeds continually, and in numerous cases as many as 60 to 70 trips per hour were being performed by magnet cranes. He explained, according to the *Birmingham Post*, that three types had been evolved—namely, the circular magnet for handling loose metal, the rectangular magnet for handling sheets and plates, and the bi-polar magnet for handling sections and billets. In Germany a number of magnets were being constructed with aluminium instead of copper coils, the advantage claimed being that the oxidation of the outer skin of the aluminium formed sufficient insulation, thereby cheapening the cost of construction considerably. Actual performances showed that when dealing with solid loads a magnet would lift as much as 5 to 15 times its own weight. A magnet 26 in. in diameter, weighing 6 cwt., would lift a block of steel weighing 100 cwt., and a magnet of 66 in. diameter, weighing 60 cwt., would lift a block of steel weighing 15 tons.

When, however, light scrap had to be handled, the capacities came down to 1½ cwt. and 12 cwt. respectively, this being due to the low weight per cb. ft., and the fact that the scrap was usually so entwined that, even if the top layers were attracted, they were sometimes pulled off by the weight of the bottom layers. These were the two extremes, and such material as pig-iron, billets, and bars came between the two limits. A magnet crane of average capacity would not cost more than £3,000 to £4,000, and with wages as they were at present, a capital expenditure of as much as £1,000 was justified to replace one man, making full allowance for depreciation, capital charges, &c., on a 10 years' purchase basis. Numerous instances of magnets saving as many as 10 men had been recorded. The greatest savings were effected when handling loose materials, as these could not possibly be slung, but material of regular shape could also be dealt with efficiently.

A Novel Sparking Plug.—A new type of plug has been placed on the French market, and is called the Bougiver, which has a glass insulator. The glass is run into the body of the plug when the latter is at a high temperature, and the joint thus made is said to be compression tight. The insulator is also peculiar in the fact that it completely fills all the space right down to the plug points. Owing to the perfectly smooth surface of small area exposed within the cylinder, the plug is said not to soot up. The plug is extremely simple, and should be cheap to produce.—*Technical Review.*

Training Disabled Men.—At the Efficiency Exhibition, included in the collective exhibit of the Ministry of Labour, the Croydon Polytechnic shows a variety of examples of work done by disabled men under the direction of Mr. F. H. Taylor, A.M.I.E.E. The exhibits include a design in teak-wood casing, trench polished; a metre wire bridge, accurately made and well finished; specimens of pipe bending, sunk pipe work, and jointing in cables and busbars; a starting panel built up of angle and flat iron, and a charging board. The high degree of manual skill attained by the trainees is remarkable, and indicates that they were not only well trained, but also very willing to learn.

New "Microscale" Balance.—M. Hans Petersson, of Gothenburg University, and Dr. Ragnar Stroemberg, of Stockholm University, have perfected a new invention called a "microscale." It is claimed for this invention that it will render it possible to register weights so small as three millionths of a milligram, and that it will thus be of great importance to establishments concerned with chemical or physical research, in cases where extraordinary precision is required. It is announced that one of these new instruments has already been ordered by the electrical laboratory of Oxford University.—*Reuter's Trade Service* (Stockholm).

Russia's Electrification Schemes.—At the eigth congress of Soviets in Moscow a report was read by M. Kryzhanovsky on electrification. According to the *Manchester Guardian* he said:—

"In the problem of increasing the intensity of labour by the mechanisation of labour, and the proper organisation of labour, the chief part belongs to electricity. A vital problem in Russia is the elimination of the fuel crisis. With the restoration of the Don Basin we shall receive 40 per cent. of the fuel we require, but it will be impossible to transport wood. Nevertheless, by using the new method of exploiting peat by water power, it will be possible to satisfy our requirements and to employ, instead of 3½ million people, only 100,000.

The construction of an electricity station in the peat bogs will afford us the opportunity of receiving cheap energy, which may be transmitted within a radius of 200 kilometres. Electricity will also play the chief part in minimising the use of oil, which the whole world requires. This will permit us to export our superfluous stock in exchange for machines.

Russia, from the earliest times, has suffered from inefficient agriculture, and, even before the war, famine was an ordinary occurrence in our land. The mechanical cultivation of land and the use of electricity will allow us to escape from the mystic circle. The regions suffering from drought will be irrigated by electricity. The land suffering from too much water will be drained by electricity. By draining bogs we can recover in the coming year 90 million acres of excellent land. Electricity will considerably increase the harvests. In the reconstruction of transport the chief part will be played by electricity. The use of electricity will permit us to convert our weak railway system into a mighty means of communication. We are dreadfully poor in metals, and electrification is the only way of obtaining the metals we require. The work of electrification is closely estimated to take ten years. It will heal the wounds of war; it will raise the economic level of Russia twice as high as it was before the war. The energy which the electricity stations will give us will be equal to the work of fifteen million people."

Pointing to a plan, M. Kryzhanovsky pointed out the construction of 27 electric stations, and when he indicated the regions in which the stations will be built small electric lamps lit up, giving the Congress an ocular demonstration of the scheme. The first station will be erected in the Don Basin.

Transport and Supply Problems in Paris.—As was mentioned a short time ago, all the surface transport undertakings in Paris and the Departement de la Seine are being acquired by the Conseil General of that department in co-operation with the City Council of Paris, and are being transferred to a new company as a purely operating company under the control of the Conseil General as from the beginning of this year. The object in view is to secure uniformity in working, and in the execution of necessary extensions, so as to be able adequately to deal with the growing traffic on the surface. A similar question has now arisen in connection with the Metropolitan and the Nord-Sud underground railways. The impression has been formed that the municipal authorities are not favourable at present to the redemption of the concessions held by the two underground companies, although a closer association of interests between the city and the companies is not improbable.

The Compagnie Parisienne de Distribution d'Electricité, which holds a monopoly of the supply branch in Paris under the Municipal Council, is now confronted with the prospect of a modification of the 1907 agreement, which appears to be an attempt to bring the undertaking into harmony with the new order of affairs arising from the war. According to a memorandum presented to the Municipal Council by M. Autrand, prefect of the Seine, the scheme proposes to put an end to all legal and other disputes existing between the company and the Council. The modifications projected under the proposed supplementary agreement refer to the tariffs, the personnel, the extensions of works, and the rental due to the city. It is calculated on the basis of index figures for coal and wages that the present charges for supply, which were largely increased early in 1920, will be the maximum, and that it will probably be possible to reduce them as from next July as a result of the fall in the price of coal. As to the company's employés, whose wages were assimilated some time ago to those of the workmen in the employ of the Municipal Council, and involved the latter in an annual expenditure of 8,000,000 fr., it is proposed to leave the wages entirely at the charge of the company in future. On the other hand, the scheme contemplates the levying by the Municipal Council of a sum of 13,000,000 fr. on the working of the company for the purpose of new works, while the rental for premises is to be increased by up to 25 per cent. It is calculated that the scheme would relieve the municipal budget by about 18,000,000 fr. per annum. At least this is the official view of the problem. It remains to be seen what the company has to say on the matter.

Electricity in Switzerland.—The Commercial Secretary to H.M. Legation at Berne has drawn the attention of the Department of Overseas Trade to the increasing demand on the part of the public in Switzerland for cheaper electricity. In the case of energy used for heating purposes the industries connected with electric heating cannot possibly exist unless the price of electricity is greatly reduced. To-day when coal and other fuel is scarce and expensive, the public is turning more and more to electricity for heating purposes, and efforts are being made to increase the number of water-power stations for the production of cheaper electricity. Unfortunately the cost of building water-power stations has increased enormously of late; it has been stated that the costs of erection are treble, and in some cases five-fold, what they were before the war. Swiss electric power stations, with very few exceptions, have been obliged to raise their prices, and electricity has become an increasingly expensive commodity. It has now been suggested that there are at present only two ways of supplying electricity at cheaper rates: One way consists in erecting larger stations and constructing more extensive artificial lakes in the high-lying mountain valleys. The second suggestion is to encourage the use of electricity during the night by reducing the charge during hours of darkness. The tendency in Switzerland seems to be to increase the number of artificial lakes, and in this way to build up reserves of water power. In the towns electricity is being increasingly used for household purposes; for ironing, for grilling, toasting, or warming up dishes, for cooking, and innumerable other purposes. The number of bakers and confectioners who bake by electricity is rapidly increasing. Chemists and dentists are also largely using electricity. A new industry is also growing up for the construction of electric stoves for the heating of private houses. The electricity used for the stoves is generated at night, during which time the stoves are heated up, whilst in the morning the electricity is switched off, and the stoves remain warm during the whole of the day. The stoves contain either water, oil, or terra cotta. In all modern houses and hotels, a large quantity of water is heated by electricity, the electricity for which is produced between midnight and 6 a.m., and which in consequence can be provided at a cheaper price. It is asserted that provided the price of electricity used at night can be sufficiently reduced, electric heating in Swiss houses will in time become the rule, and not, as now, almost the exception. At the present cost of coal and wood the hydroelectric plants supply the bakeries with electricity at a price more favourable than that for which coal or wood could be furnished. For producing 100 kilos of bread there is used on an average 20 kilos of coal at a cost of 4.05 francs. An electrically-heated oven uses about 80 KW.-hours for the same amount of bread. At a price of 3 centimes per kW-hour for a supply at night, the electricity costs only 2.40 francs. Even the day supply can be used in successful competition with the coal-heated ovens. When baking about 37,000 kilos of bread per day a saving of 370 tons of coal per month is effected. The present demand for the installation of electrically-heated ovens is considerably in excess of the ability of the Swiss manufacturers to supply them.

Appointments Vacant.—Technical assistant, Grade I (£300), two ditto., Grade II (£250); repairs superintendent, £300 +, for the L.C.C. Tramways Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—MAGNETIC SUSCEPTIBILITY OF LOW ORDER.—Prof. E. Wilson, M.I.E.E., delivered the first and second of a series of three lectures on the above subject before the Institution, on February 17th and 24th respectively, and the third lecture is to be delivered on March 17th. One of the most important problems at the present time is that of magnetic separation of minerals; therefore, their susceptibilities must be considered, and since the magnetic properties of certain minerals can be changed by oxidation or reduction, it follows that this and other aspects of the problem must also receive attention. But apart from magnetic separation, the subject of rock susceptibility has a bearing on magnetic survey work, a knowledge of the subject is necessary to those engaged on the construction of scientific instruments, and there are possibilities of its application in other directions.

The author dealt with the subject primarily from the standpoint of its practical applications, and his first lecture was devoted to a description of the instruments used in the experiments; the second dealt with the results obtained, and the third will outline their practical applications. The lectures were illustrated by means of diagrams and lantern slides; apparatus was exhibited, and experiments were performed.

I. *Instrumentation.*—When the volume susceptibility is larger than about 0·15, the correction for "end-effect" with short thick bars becomes too uncertain if the magnetometer is employed. Weiss prolonged the specimen in each direction by soft iron bars, the whole being placed in a solenoid, and the magnetising force was inferred from the difference in e.m.f. induced in the two sections on reversing the magnetising current. Other methods are to insert the specimen in holes in the pole pieces of a ring-shaped yoke of "Stalloy," and by supplementing the magnetometer with an induction balance, Rücker measured susceptibility as low as 0·00013. Wiedemann and Currie's torsion balance covers the range of the magnetometer; its upper limit is at most 0·15, and with it measurements can be made to less than 1×10^{-6}. If the instrument is to have a wide range of utility it must be so constructed that the strength of the magnetic field can be varied; such an instrument was exhibited by the lecturer. Moreover, a portable torsion balance has been developed, in which the test-piece hangs between fixed soft-iron pole-pieces which are magnetised by two concentric rings of hardened tungsten steel with north and south poles at opposite ends of a diameter. By varying the relative azimuths of the rings, the field between the pole-pieces can be varied. In this manner a variable field can be obtained without the use of a magnetising coil and battery.

In the case of the torsion balance the deflection varies as the square of the magnetic force impressed upon the test-piece. In fact, it is difficult to measure the susceptibility of a given specimen outside a narrow range of magnetic force of about one to four or five. An electromagnetically-controlled balance has been developed, which permits of a wide range of variation of the magnetic force. The force due to torsion is replaced by an electromagnetic control in which the mechanical force exerted is due to two components—one proportional to the magnetic force impressed upon the test-piece, and the other variable if the susceptibility varies. The instrument can be modified by replacing the electromagnets by permanent magnets after the manner of the portable torsion balance. The test-piece is supported from the beam, and the position of the magnet must be such that when the test-piece is just about to leave the field the pointer is at zero of the scale, thus eliminating the torsion in the fibre.

If the strengths of the magnetic fields are fixed in value, then the mass susceptibility, for equal weights, is proportional to the current in the moving coil. But the entire range ($\kappa_v = 0{\cdot}15$ to less than 1×10^{-6}) would necessitate a weakening of the field in the permanent magnet when the susceptibility became high in which case the ratio of the squared values of the fields has to be taken into account.

II. *Susceptibility Values.* — Magnetite crystals have curves of magnetisation resembling those of iron, and the susceptibility along the axes of the crystal varies in magnitude for a given magnetising force, although all tending to the same limiting value. The volume susceptibility can have a maximum value of the order of 10 C.G.S. units, the largest susceptibility of any known natural substance, excluding meteorites and traces of metallic iron.

Arkansas magnetite will interest engineers on account of its high retentivity and coercive force. The value of κ_v is increased

about 42 per cent. on heating to 1,000° C., the residual magnetism is also increased, but the coercive force is reduced, and this agrees with what happens in the case of hardened steel. As Arkansas magnetite is so highly retentive, and may possibly be found useful for the purposes of permanent magnets, it is of interest to compare its magnetic properties with those of hardened tungsten steel. The ergs per cycle per cb. cm. are 90,000 when the value of B_{max} is 525, whereas they are of the order 200,000 in tungsten steel. The coercive force of the tungsten steel is roughly half that of this magnetite, but the retained magnetism is very much larger, the values being about 10,000 in the case of tungsten, and 1,300 in the case of this magnetite. That reverse force H which, being less than the coercive force, gives a maximum value to the product B H, is about 38 in tungsten steel, as against 80 in this magnetite, and the maximum values of B H are 270,000 and 46,000 respectively. The intensity J retained by a 4-cm. bar after being in a magnetic field H of 18,000 C.G.S. units has diminished 20 per cent. in 2½ years. The effect of heating Penryn magnetite to 1,000° C. is to increase the susceptibility, coercive force and retentivity. The intensity of magnetisation J in the unheated 4-cm. bar has only diminished 3·5 per cent. in 2½ years.

The lecturer examined the properties of other natural minerals whose composition can be represented by a formula of the same type as that of magnetite [Fe O . Fe_2 O_3], and pointed out that another example which would interest engineers was that of the mineral chalybite (spathic ore or ferrous carbonate). A specimen highly oxidised on the surface was tested as regards the susceptibility of the surface layer and the innermost unweathered portion. The value of κ_m of the surface layer was found to be $84{\cdot}7 \times 10^{-6}$, whereas for the innermost portion the value of κ_m was 103×10^{-6}. The highly oxidised portion has a susceptibility almost identical with specimens of red or brown hematite. After roasting with free access of air both the oxidised layer and the innermost portion gave almost the same values of κ_m, namely, 0·014 and 0·0138. The high susceptibility found in ferric oxide is associated with the passage through the stage of magnetite during its production, but an inspection of chrome iron ore and hornblende shows a reverse effect, that is, a diminution is produced by heating.

The effects of heating and cooling freely in air certain minerals in powder form was next dealt with; the analysis of the compounds at the various stages of heating is still under consideration, but it is indicated by the experiments that a different susceptibility can be obtained by heat treatment according to fineness of division and access of air, and this is important in the event of large quantities having to be dealt with.

The transformation temperatures of natural and artificially prepared minerals and alloys have been examined by many workers, and the results published. The magnetic properties of salts have been investigated by many workers, and it is an interesting fact that copper has a negative susceptibility and its salts are positive, whereas magnesium is positive and its salts are negative. Wiedemann showed as early as 1865 that paramagnetic salts when hydrated give a higher value than the anhydrous salts, although water itself is diamagnetic.

Summer Meeting.—The summer meeting of the Institution will take place in Scotland on June 7th to 10th, and will include visits to Glasgow, Fort William, and Oban.

North-Western Centre.—The syllabus for the second half of Session 1920-1921 is as follows:—March 8th, "Electric Driving in the Paper Mill on Heat-Economy Lines," by A. B. Mallinson; March 22nd, To be announced later; April 6th (Wednesday), Popular lecture, by Prof. E. W. Marchant, D.Sc., on "Modern Developments in Wireless Telegraphy and Telephony"; April 12th, Annual general meeting and smoking concert.

North-Eastern Students' Section.—On January 28th, Mr. C. C. Paterson, O.B.E., M.I.E.E., gave an address entitled: "The Electric Lamp from the Inside," in which detailed information upon the manufacture of an electric lamp was given. The speaker also dealt with the "Edison effect," and the metallurgy of tungsten.

Manchester Wireless Society.—On February 16th, Mr. J. McKernan lectured on "Colour Photography," to a large audience. The lecture was illustrated by some wonderfully-tinted photographs taken by the speaker.

Institute of Post Office Electrical Engineers.—At a meeting of the Bristol Centre on February 15th, Mr. A. J. Stubbs, Assistant Engineer-in-Chief, gave an address on "Fifty Years of State Telegraphs," which was confined to the historical side of the subject.

Physical Society of London.—At the annual general meeting, on February 11th, the reports of the Council and the treasurer were unanimously adopted. The officers and Council elected for the ensuing year are the following:—President, Prof. Sir W. H. Bragg, C.B.E., M.A., F.R.S.; secretaries, Messrs. F. E. Smith, O.B.E., F.R.S., National Physical Laboratory, Teddington; D. Owen, B.A., D.Sc., 62, Wellington Road, Bush Hill Park, N.; foreign secretary, Sir Arthur Schuster, Ph.D., D.Sc., F.R.S.; treasurer, Mr. W. R. Cooper, M.A., B.Sc., 82, Victoria Street, S.W. 1; librarian, Prof. A. O. Rankine, D.Sc., Imperial College of Science and Technology. After the conclusion of the general business, a discussion on "Absolute Measurements of Electrical Resistance, and Instruments based on the Temperature Variation of Resistance," was held.

Royal Institution.—On Saturday, March 5th, at 3 o'clock, Sir Ernest Rutherford will deliver the first of a course of three lectures at the Royal Institution on "Electricity and Matter." The Friday evening discourse, on March 4th, will be delivered by Mr. W. A. Tait on "Severn Crossings and Tidal Power."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The Times states that Mr. John Noble, the vice-chairman of Sir W. G. Armstrong, Whitworth & Co., Ltd., and Mr. R. Waters, the head of the company's commercial organisation, are sailing this week on an extended business mission to South America.

Mr. W. R. Montgomery, A.M.I.E.E., for some years on the engineering staff of the E.P.S. Co., and until lately sales engineer to Mr. H. P. Girling, M.I.E.E., of Maldon, has joined the staff of Messrs. Agricultural and General Engineers, Ltd., Central House, Kingsway, W.C. 2. He will be responsible for the sales in the eastern zone of the associated firms' electrical products, including the "Garrett" electric vehicle.

Mr. J. M. Keenan, late deputy borough electrical engineer at Torquay, has been appointed engineer and manager of the Thanet Electric Co., Ltd., Margate.

Mr. Leonard Harvey, of 25, Victoria Street, Westminster, who has during the past few years made a special study of pulverised coal applications and uses, and has been representing an American firm as European manager, is relinquishing this position, and will practise as a consulting engineer upon matters pertaining to pulverised coal and colloidal fuel, at the address mentioned.

Messrs. H. W. Smith & Co. (1920), Ltd., have appointed Mr. S. M. Hammett (who was for some years with Messrs. Baxendale and Co., Ltd.), as their representative in Lancashire.

Mr. A. Flinders Caine has resigned his position as manager of the heating and cooking department of the Edison Swan Electric Co., Ltd., Ponders End.

Obituary.—Mr. R. Rankin.—We regret to record that the death of Mr. Robert Rankin, B.Sc., occurred at his residence at Leamington on the 17th inst. Since 1918 deceased was managing director of Messrs. Van Raden & Co., Ltd., Coventry. He commenced his training in the engineering profession when 15 years old, and became assistant to the Professor of Electrical Engineering in the Glasgow and West of Scotland Technical School. After having been in business in London with the Electrical Storage Co., and subsequently with Messrs. Pritchetts & Gold, Mr. Rankin undertook Government work during the war, and subsequently took up his Coventry appointment. In 1918 he was elected chairman of the Junior Institution of Engineers, and he was the holder of the Vickers Prize Gold Medal of that body, 1915-16, and the bronze medal, 1917-18. He was the author of a work upon "Electric Accumulators," and joint author of an electrical laboratory course for junior students. As one of the leading members of the Informal Meetings Committee of the Institution of Electrical Engineers, full of native humour and ready wit, he was extremely popular; and as a technical man he had a very promising future. Deceased, who was only 35 years of age, leaves a widow and three children.

Mr. J. H. Carson.—We regret to record the death which occurred in London on February 19th, of Mr. James Hamilton Carson, late manager of the Anglo-American Telegraph Co., Ltd., in his 81st year.

NEW COMPANY REGISTERED.

James Antifouling Appliances, Ltd. (173,121).—Private company. Registered February 12th. Capital, £3,000 in £1 shares. To acquire from J. E. James and others the benefit of certain existing inventions relating to the manufacture and working of improvements in electrical apparatus for protecting the hulls of ships and other submerged structures from barnacles and other forms of aquatic life. The subscribers (each with one share) are: W. H. Larter, 67, Wynnstay Gardens, W. 8, engineer; H. Neville, "Ambleside," Downs Court Road, Purley, engineer. The first directors are: J. E. James, of Bolton; J. B. Wilkie, of Liverpool; and one other to be appointed by holders of shares No. 2,085 to 3,000 inclusive. Secretary: W. H. Larter. Registered office: 1a, Cockspur Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ilford Dry Battery Co., Ltd.—Debentures dated February 2nd, 1921, to secure £1,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: R. Balckie, 3, Clarence Road, Nottingham.

Europe and Azores Telegraph Co., Ltd. (39,452).—Capital £200,000 in £10 shares. Return dated December 15th, 1920. All shares taken up. £144,320 paid. £55,680 considered as paid. Mortgages and charges nil.

Berry's Electric, Ltd.—Memorandum of deposit on February 3rd, 1921, to secure all moneys due or to become due from company to London Joint City & Midland Bank, Ltd., charged on company's interest in land in Spring Road, Yardley, Birmingham, with factory thereon.

Tok Manufacturing Co., Ltd.—Satisfaction in full on February 11th, 1921, of debentures dated July 28th, 1920, securing £2,000.

Electrical Finance & Securities Co., Ltd.—Particulars of £20,000 debentures, authorised December 16th, 1920, and covered by trust deed dated February 3rd, 1921; present issue £17,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Union Commercial Investment Co., Ltd.

CITY NOTES.

Fife Tramway, Light and Power Co., Ltd.

Mr. George Balfour, M.P., presiding at the annual meeting, held at Edinburgh on Friday, said it was very satisfactory, in face of all the trade depression, that they were able to produce a satisfactory account. After dealing with the accounts of the tramway undertaking, he said that the Fife Electric Power Co. showed a substantial increase in net revenue due to the large expenditure on capital account which had been made in previous years. The gross receipts amounted to £114,905, compared with £73,560 for 1919. The net trading profit, including the profit under the Electric Lighting Orders, amounting to £36,998, as compared with £21,990 in the preceding year; 19,579,000 units were sold from the power station at Townhill, compared with 14,891,000 for 1919. The consumers connected numbered 2,995, an increase of 449. During the last three years the number of consumers connected had been more than doubled. The demand for electricity continued unabated, as was evidenced by the figures, and by the fact that at the moment some 150 consumers, large and small, were awaiting connection. The total load connected with the power station was approximately 11,840 kW, compared with 8,830 kW for the preceding year. Various extensions to the plant had been carried out during the year to cope with the increasing demands and for the purpose of effecting economies in supply. After referring to the electric lighting orders in the Cowdenbeath area and in various parts of the county of Fife, Mr. Balfour said these undertakings were granted direct to the company, and a supply of electricity was given over a large and scattered area under the provisions of these orders, the supply being obtained in bulk from the Fife Electric Power Co. The issued share capital now stood at £720,000, an addition of £320,000 for the year. The gross revenue from the traction, lighting, and power undertakings amounted to £72,801, compared with £48,393 for 1919. The directors recommended a dividend on the ordinary shares at the rate of 8 per cent. per annum, being the same rate as was paid on a considerably smaller capital for the previous year. They had no doubt shareholders would endorse the policy they had adopted of strengthening the reserves by the appropriation of £20,000 and of paying the same dividend to the ordinary shareholders as was received last year. The directors felt sure that this policy would appeal to the shareholders as being a sound and prudent one to follow, particularly under the present financial conditions.

Underground Electric Railway Companies.

The ordinary general meetings of the five companies forming this group were held at Caxton Hall, Westminster, on February 17th, Lord Ashfield (chairman) presiding. The reports of the companies were abstracted in our last issue.

At the City and South London meeting, the chairman stated that the passing of the London Electric Railways Fares Act had enabled the business to approach a level of financial stability, and the receipts in the last three months of the year showed a 30 per cent. advance upon those of the first three months, but the number of passengers carried fell by 14 per cent. The difficulty of raising the £1,750,000 required for the reconstruction of the railway had prevented any progress in this direction, but the directors hoped to commence the work when funds were available on reasonable terms. The principles of grouping outlined by the Minister of Transport possessed many obvious advantages, and would be acceptable to the group. The positions of main line railways and the London lines were very different, however. The former were extensive and fully developed, whereas the underground railways were still unfinished, and required much more capital for their completion. With a probable decline in working costs the position of the companies would improve considerably in the near future.

The chairman explained at the meeting of the shareholders of the Metropolitan District Railway that the company was one of those taken over by the Government at the beginning of the war. One of the terms of control was that the net revenue of 1913 should be guaranteed to the company. When the common fund of the group was set up in 1915 this arrangement was modified. The increased fares were allowed on the understanding that the special arrangement of 1915 was cancelled. This was found impracticable, and it was agreed, therefore, that the railway should be freed from Government control; this decision had been justified by the improved condition brought about by the increase in fares. The receipts of the four railways had increased by 23 per cent. during the last quarter, as compared with the first three months of the year, although the number of passengers carried had fallen by 10 per cent. Speaking of future developments, Lord Ashfield said that the construction of a Hampstead and Edgware line through Hendon to Golders Green was being considered; Parliamentary powers had been received for this work. This line should be proceeded with immediately, as it would prove a very remunerative undertaking. The speaker looked for useful developments from the negotiations taking place between the authorities concerned with the London traffic problem; if a successful outcome could be arrived at the result would be simplification and improvement. Lord Ashfield told the shareholders of the Central London Railway Co. that their undertaking had benefited most from the increase in fares, the increase as between the first and last quarters of the year having been 35 per cent.; this was partly due to a small increase in the traffic. The traffic upon the new Shepherd's Bush-Ealing extension was at present unsatisfactory, but hopes of improvement were entertained by the directors. The chief obstacle to its growth was that main line fares were being charged. The G.W.R. Co. was contemplating the provision of two additional stations on this extension at Old Oak Common and Twyford; these should materially increase the number of passengers carried. Referring to future developments, the speaker said that Parliament had sanctioned the construction of a connecting line with the London and South Western Railway at a point near that company's station at Shepherd's Bush. This would provide a through run to Richmond. Although this work would be carried out at the earliest possible moment, the present financial stringency prevented an immediate commencement.

At the meeting of the London Electric Railway Co., Lord Ashfield said that the position had taken a turn for the worse during the present year, two members of the group having incurred a deficit. The result of this had been that the common fund had had a distributable amount of £354,492, as compared with £496,387 in the previous year. This was due to the delay in sanctioning the increases which were finally put into force in September last. Since that date, however, the receipts had advanced by 27 per cent., comparing the first and last quarters, and the number of passengers had been reduced by only 12 per cent. The expenditure on capital account of £88,404 was chiefly on account of joint rolling stock for the extension to Watford over the L. & N.W. Railway, of the cost of which one-third was paid by the company. Capital commitments amounted to £182,500, chiefly due to the purchase of 40 new trailer cars for the Bakerloo section, and improvements to the lifts to expedite their working. Future works included the construction of a line linking up the Hampstead section with the City and South London Railway. This would cost about £1,142,000, but the present time was not propitious for the raising of this amount. Upon the whole, the chairman said he could not consider the year under review as satisfactory, but he hoped to report a substantial improvement at the next annual meeting.

Tyneside Tramways & Tramroads Co.—At the half-yearly meeting, held in Newcastle-on-Tyne on 15th inst., Mr. J. T. Merz said that the year had been an exceptional one in many ways, but especially in their business. In other concerns prices could be advanced to meet the needs of the moment, but they had to go to Parliament before they could increase fares. Going to Parliament, however, meant a delay of six months, which had a due effect on the balance sheet. However, the next half-year should show a normal state of affairs in the business of the company. Owing to the coal strike in October the autumn races at Gosforth were abandoned; that meant a loss of revenue. The dividend was only 4 per cent., as against 5 per cent. for 1919, and 6 per cent. for 1918.

City of London Electric Lighting Co., Ltd.—Dividend on the preference shares 6 per cent., being 1s. 2.4d. per £1 share; on the ordinary shares 12 per cent., being 2s. 4.8d. per £1 share. On account of these dividends 7.2d. per preference share and 9d. per ordinary share was paid in September, 1920. In addition, the directors recommend a bonus of 2 per cent. per ordinary share, being 4.8d. per £1 share, on account of the reduction of dividend for the year 1916, leaving the reductions in 1917 and 1918 to be dealt with in the future. This bonus will also be subject to deduction of income tax. After payment of the dividends and bonus less income tax, and providing for other appropriations, £23,000 will remain to be carried forward.

Midland Electric Corporation for Power Distribution.—Final dividend at the rate of 6 per cent. on the ordinary shares, making 10 per cent. for the year; on the new ordinary at the rate of 10 per cent. Carried forward subject to E.P.D., £36,486.

Tramways, Light and Power Co.—Profit for 1920, £53,697 plus £3,833 brought forward. After paying debenture charges and putting £5,000 to reserve, 6 per cent., less tax, is paid on the ordinary shares. £2,256 is carried forward.

Paisley Tramways Co.—After paying preference interest and putting £1,000 to preference sinking fund, £65,457 is carried forward.

Mansfield and District Tramways Co., Ltd.—It is proposed to increase the capital from £130,000 to £180,000 by the creation of 50,000 new ordinary shares of £1.

Melbourne Electric Supply Co., Ltd.—Resolutions authorising the recent issue of 8 per cent. £5 preference shares were confirmed at a meeting held on Tuesday.

Northampton Electric Light & Power Co., Ltd.—The business showed considerable expansion during 1920, and there was an increase in net profit. Units sold increased from 6,589,108 to 7,646,577. The balance of the new 7 per cent. second debenture stock will be offered shortly. The capacity of the Hardingstone Junction generating station is to be increased; the engine and boiler houses will be enlarged, and orders for a 6,000-kW turbo-alternator, boilers, &c., have been placed. £12,360 has been put to depreciation (£1,360 allocated to motors, of which 4,607 h.p. are let out on hire). A battery suspense fund is being formed to spread the occasional heavy expenses for repairs over a longer period. After paying 5 per cent. on the preference shares and 8 per cent. on the ordinary for the year, £1,500 is to be carried forward.

County of London Electric Supply Co., Ltd.—Final dividend on the ordinary shares for the past half-year at the rate of 11 per cent. per annum, less tax, making 8 per cent. for the year. £50,000 to depreciation; £62,500 to general reserve; £18,500 forward.

Stock Exchange Notices.—The following have been ordered to be officially quoted:—

Erinoid.—265,278 shares of 5s. each, fully paid, Nos. 700,001 to 965,278.

Melbourne Electric Supply Co.—£96,365 consolidated ordinary stock.

Dealings in the following have been specially allowed by the Committee, and the shares are now included with those in which special settlements have already been granted:—

Major & Co.—79,510 8 per cent. participating preferred ordinary shares of £1 each, fully paid, Nos. 1 to 79,510; and 20,000 ordinary shares of £1 each, fully paid, Nos. 1 to 20,000 (issued to deferred ordinary shareholders).

Smithfield Markets Electric Supply Co., Ltd.—Gross profit for 1920 £9,262, against £6,588 in 1919; net profit £8,718, against £5,464 in 1919. £3,500 to depreciation; £800 to debenture stock redemption fund. After including the balance at credit of profit and loss account at end of 1919, £5,748 remains. A dividend of 5 per cent. per annum on the ordinary shares requires £3,000; to reserve £2,000; carried forward £748. The removal of official control of the markets in July, 1920, re-established normal conditions during the second half of the year, resulting in a satisfactory increase in output.

Rushden & District Electric Supply Co., Ltd.—Connections greatly increased during 1920; consumers (chiefly for lighting) grew from 223 to 308, but owing to the depression in trade during the last six months, the output of electricity has remained stationary. When trade revives considerable expansion is expected. Maximum load, 365 kW; units sold, 581,220. £1,075 to depreciation, £100 written off preliminary expenses; final dividend 4 per cent., making 6½ per cent. for 1920. £316 forward.

Tullamore Electric Light & Power Co., Ltd.—At a general meeting of this company, Mr. P. J. Egan presiding, the directors reported that 11,835 £1 shares had been issued for cash—5s. per share, payable on application; that the purchase of dynamo and engine, consulting engineer's fees, absorbed £1,950, and purchase of power house £175; and that preliminary expenses were estimated at £800. Mr. Kelly (secretary) said the machinery would be installed by March, and all should be in readiness for lighting the town in October next.

Liverpool Overhead Railway Co.—Gross revenue receipts for 1920 £229,130; working expenses, including appropriation to reserve, £199,881; leaving £29,248, plus £6,015 brought forward. Debenture interest £6,755; dividends for the year 5 per cent. on the preference shares and 3 per cent. on the ordinary; £5,577 forward. Passengers carried: 1920, 21,020,839; 1919, 22,440,103.

Charing Cross, West End & City Electricity Supply Co., Ltd.—Dividend on the ordinary share capital of the West End undertakings for the half-year ended December 31st, 1920, at the rate of 5s. 6d. per share, making, with the interim dividend already distributed, 8 per cent. for the year 1920.

Bournemouth & Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, making 6 per cent. for 1920.

Chelsea Electricity Supply Co., Ltd.—Dividend of 7 per cent. for the half-year, making 6 per cent. for the year; £17,312 to depreciation; £2,178 written off cost of extinction of founders' shares; £2,925 written off investments; £2,429 carried forward.

Traction & Power Securities Co.—Net revenue for 1920 £33,819, plus £10,932 brought forward. Dividend 7s. 6d. per share, free of tax, carrying forward £12,722 subject to corporation tax.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—Dividend of 5 per cent. on the ordinary shares for the last half-year, making 9 per cent. for the year.

India.—Ahmedabad Electricity Co., Ltd.—Fourth dividend for the year ended September 30th, 1920, at the rate of 10 per cent. per annum.—*Indian Textile Journal.*

National Boiler & General Insurance Co., Ltd.—Dividend of 18s. per share, less tax, for 1920. To investment reserve £6,841; carried forward £3,949.

STOCKS AND SHARES.

Tuesday Evening.

The electricity supply companies are certainly doing well in regard to their dividend announcements. Up to the time of writing, increases have been declared by the City of London, Chelsea, Charing Cross, Kensington, Metropolitan, and South Metropolitan companies. There may be others to come. In no case has the 1919 dividend been diminished. This is a performance which cannot fail to be observed when trade conditions become more normal and investors are looking round for opportunities to place their money in commercial undertakings offering prospects of steady improvement. It is interesting to compare the results of the past three years as follows:—

	1920 p.c.	1919 p.c.	1918 p.c.
Charing Cross	8	7	4
Chelsea	6	4	3
County	8	8	7
Kensington and Knightsbridge ...	9	7	6
London	2½	2½	nil
Metropolitan	7	6	5
St. James's	12	12	10
South Metropolitan	8	6	6
Westminster	10	10	8

The City of London dividend makes 14 per cent. altogether, as against 13 per cent., in all, a year ago.

Prices are harder. Westminsters have advanced to 5¼ and Metropolitans to 3. County preference are 5s. higher at 8½. The rest are firm at the quoted figures. Sir Eric Geddes stated in the House of Commons on Monday that the Ministry of Transport had received many applications from supply companies for permission to put up the price of electricity. Sir Eric was guarded in his remarks, but apparently the applicants have not been sent empty away in all cases.

In spite of the firmness in the market for supply shares, a fairly general decline has taken place in the list of prices in the shares of manufacturing companies. Amongst those which have fallen this week are English Electric 13s., Electric Constructions 13/16, General Electrics 1 3/16, Siemens 19s. 4½d., the new at 18s. 3d., Metropolitan-Vickers ordinary 18s. 1½d., and Edisons at 10s. The disappointment felt in connection with the Edison dividend is reflected in apprehensions that other manufacturing companies may not be able to keep up their previous distributions, and having regard to the tightness of money, it is not unreasonable to regard such fears as justifiable. People are afraid to buy anything of the manufacturing type of share at the present time, and therefore when there is any slight pressure to sell, prices have to give way, because there is no support to back them. Callender's 6½ per cent. preference, however, are in request, the price being better at 17s. 6d.; the 7½ per cent. preference hardened to 19s. 3d.

The Home Railway market has again been very flat, with substantial falls in debenture, preference, guaranteed, leased lines, and other prior-charge securities. There seems to be no stopping the fall in this particular market, a fall started by the Colwyn report and accelerated by the growing nervousness felt as to the Government's readiness to discharge its obligation to hand back the railways next August in as good a condition as they were taken over from the companies upon the outbreak of war. The Undergrounds are exceptional in the list of ordinary stocks as showing a fair amount of strength, speeches at the various meetings of the Underground companies last week serving to maintain prices, although here also there has been some little reaction from the best. Underground incomes are 2 points higher at 70½. District 4 per cent. debenture has fallen to 52½, and the company's 4 per cent. debenture of 1902-3 is weaker at 52.

It may be remarked parenthetically that a firm of outside brokers is sending out circulars offering Contingent Certificates of the Underground Electric Railways of London at 1s. 3d. each net. The firm are prepared to sell the shares for cash outright or on the instalment principle. Curiosity may wonder where the certificates are coming from to supply the demand, but as they are obtainable in the Stock Exchange at about sevenpence apiece, it is not difficult to understand the source of supply.

Cable stocks show little disposition to halt in their steady upward march. This week, rises are marked in Western Telegraphs at 16¼ and Eastern Extensions 15½. Eastern ordinary has been 162, but reverted to 160½, while Great Northerns are ¼ down at 21¾. Indo-Europeans, which for some time past has been quoted at the extraordinarily wide margin of 25—35, changed hands the other day at 26 and 26½. Holders of stocks in the Eastern group of companies are being exhorted in some quarters to watch with close attention the developments in connection with the Great Northern and Indo-European companies, since as soon as these two get going in full swing again, they may prove formidable competitors to the Eastern and its associated companies. Under ordinary trade conditions, however, there is plenty of room and plenty of traffic for them all. Anglo-American preferred at 81½ is a point lower. Orientals weakened to 2 3/16, and Marconi's are heavy at 1¼, while Radios of both classes are a trifle down at 8s. 3d. for the

common and 11s. 3d. for the preferred. There is nothing doing, however, in any of the Marconi shares, and the dullness of the market is due to the indifference shown by those who commonly support Marconi's when prices are depressed.

British Columbia deferred has gone back 3 points to 48½, with business marked as low as 47½. Considering the high yield offered by the stock, it is difficult to account for the flatness in the price. Financial affairs in the Dominion, however, seem to be none too happy, according to the private letters, and the tightness of monetary conditions is as noticeable there as it is on this side of the Atlantic. Mexican issues have gone back, the principal fall this week being one of 3½ points in Mexican Light & Power preferred shares. Anglo-Argentine Tramways second preference gave way to 3½, the 5 per cent. debenture stock, however, advancing to 60½, the stock being steadily absorbed by the smaller investor. British Electric Traction 5 per cent. debenture is harder at 61.

The rubber market is virtually dead. The various panaceas put forward to assist the price of the raw produce make no headway against the apathy of raw rubber buyers, and, until a change occurs in business conditions in America, it is not likely that the price of rubber will make any material improvement. The weakness of armament shares was arrested by a slight recovery in Vickers, which assisted Armstrongs and other members of the group, but the market in the shares as a whole does not appear to have much staying power, and the recovery was partially lost. It is well, however, to keep in mind the fact that E.P.D. comes off before long, and that the payments which have been made by industrial companies on account of this tax constitute a kind of hidden reserve that will be of assistance to some of the companies most heavily hit.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 23, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	10 0 0
do. do. do. 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	8	4	3½	—	9 10 6
City of London	8	10	24/3	—	8 5 4
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7⅛	—	10 18 4
do. do. 6 per cent. Pref.	6	6	6⅛	+ ⅛	7 7 8
Kensington Ordinary	6	7	5⅝	—	11 14 4
London Electric	Nil	2½	¾	—	10 0 0
do. do. 6 per cent. Pref.	6	6	2½	—	10 18 0
Metropolitan	8	8	6	+ ⅛	11 13 4
do. 4½ per cent. Pref.	4½	4½	2⅛	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	3⅛	—	9 2 10
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	5½	+ ⅛	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	8	8½	−1	7 9 3
do. Def.	33/6	1½	16⅛	—	9 6 6
Chile Telephone	8	8	6⅝	—	*5 6 8
Cuba Sub. Ord.	7	7	6½	—	10 15 4
Eastern Extension	10	10	15⅝	+ ⅛	*6 8 0
Eastern Tel. Ord.	8	10	16/-	—	*6 4 5
Globe Tel. and T. Ord.	8	10	15⅜	—	*6 8 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	21½	— ½	10 2 4
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	1⅞	—	—
Oriental Telephone Ord.	10	12	2⅛	— ⅛	*5 9 7
United R. Plate Tel.	8	8	6½	—	*6 8 0
West India and Panama	1/8	Nil	1/16	—	Nil
Western Telegraph	8	10	16⅛	+ ⅛	*6 5 0
Home Rails.					
Central London Ord. Assented	4	4	43½	—	9 4 8
Mesropolitan	1	1½	20½	—	7 6 4
do. District	Nil	Nil	10	—	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	5	4	73½	+ 2	2 16 9
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	28	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	8⅛	— ⅛	Nil
do. do. 5 % Deb.	5	5	60½	+1	8 8 0
Brazil Tractions	Nil	Nil	3⅜	—	Nil
British Columbia Elec. Ry. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	53½	—	*8 16 0
do. do. Deferred	Nil	3	48½	— 3	*12 17 8
do. do. Deb.	4½	4½	67½	+2	7 10 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	— 2	Nil
do. 6 per cent. Bonds	Nil	Nil	9½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	−3½	Nil
do. 1st Bonds	Nil	Nil	63½	—	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	9½	—	6 13 8
British Aluminium Ord.	10	10	17/-	— 3d.	11 15 4
British Insulated Ord.	12½	15	13⅜	—	9 5 10
Callenders	25	15	13⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	24⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—9d.	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	13	— ½	13 6 2
English Electric	—	8	12/-	—	10 19 2
Do. Pref.	—	6	14/-	—	8 11 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 6
do. Ord.	10	10	1⅝	— ⅛	*8 8 5
Henley	25	15	1⅛	—	10 5 0
do. 4½ Pref.	4½	4½	3⅜	—	6 13 6
India-Rubber	10	10	¾	—	—
Met.-Vickers Pref.	—	8	1½	—	8 15 4
Siemens Ord.	10	10	8⅛	— ¼	*10 6 2
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 22nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/1	3d. dec.
a Ammoniac Sal	per ton	£100	£10 dec.
a Ammonia, Muriate (large crystal)	,,	£73	£3 dec.
a Bisulphide of Carbon	,,	—	—
a Borax	,,	£38	—
a Copper Sulphate	,,	£35	£3 dec.
a Potash, Chlorate	per lb.	7d.	½d. dec.
a ,, Perchlorate	,,	10d.	2d. dec.
a Shellac	per cwt.	£16	10s. dec.
a Sulphate of Magnesia	per ton	£16	£2 dec.
a Sulphur, Sublimed Flowers	,,	£52	£4 dec.
a ,, Lump	,,	£18	—
a Soda, Chlorate	per lb.	4½d.	½d. dec.
a ,, Crystals	per ton	£7	—
a Sodium Bichromate, casks	per lb.	1/-	—
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	—
c Brass (rolled metal 3" to 12" basis)	per lb.	1/0½	—
c ,, Tubes (solid drawn)	,,	1/2½ to 1/2½	½d. dec.
c ,, Wire, basis	,,	1/0½	—
c Copper Tubes (solid drawn)	,,	1/4½	½d. dec.
c ,, Bars (best selected)	per ton	£130	£4 dec.
c ,, Sheet	,,	£120	£4 dec.
c ,, Rod	,,	£123	£4 dec.
d ,, (Electrolytic) Bars	,,	£73	£2 inc.
d ,, ,, Sheets	,,	£143	—
d ,, ,, Wire Rods	,,	£95	£1 inc.
d ,, ,, H.C. Wire	per lb.	1/0½	½d. inc.
f Ebonite Rod	,,	8/6	—
f ,, Sheet	,,	8/-	—
n German Silver Wire	,,	2/9	—
h Gutta-percha, fine	,,	14/- to 16/-	—
h India-rubber, Para fine	,,	11½d.	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	—
l ,, Wire, galv. No. 8, P.O. qual.	,,	£50	—
g Lead, English Pig	,,	£20 15s.	65/- dec.
g Mercury	per bot.	£12 10 to £12 15	—
e Mica (in original cases) small	per lb.	6d. to 4/6	—
e ,, ,, ,, medium	,,	5/- to 10/-	—
e ,, ,, ,, large	,,	12/6 to 25/- & up	—
p Phosphor Bronze, plain castings	,,	1/5 to 1/10	1d. dec.
p ,, ,, rolled bars and rods	,,	2/4 to 2/7	1d. dec.
p ,, ,, rolled strip & sheet	,,	2/4 to 2/6	1d. dec.
d Silicium Bronze Wire	per lb.	1/4	—
r Steel, Magnet, in bars	,,	1/8	—
n Tin, Block (English)	per ton	£165 to £166	£8 inc.
n ,, Wire, Nos. 1 to 16	per lb.	4/6	—
p White Anti-friction Metals	per ton	£78 to £300	—

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
p ——
r W. F. Dennis & Co.

Mersey Railway Co.—The report for 1920 states that the total amount available for payment of interest is £48,815, which has been applied as follows: Interest on new first perpetual debenture stock £26,775, interest at 4 per cent. on the 1866 debenture stock; 3 per cent. on the 1871; 3 per cent. on the 1882-3-5 stock; and 1½ per cent. on the "B" debenture stock; leaving £58 to carry forward. The directors have applied to the Ministry of Transport for the exclusion of the railway from the Government grouping scheme.

Tasmanian Zinc Works.—Press reports to hand show that it was decided to cease production on December 31st last at the Electrolytic Zinc Co.'s works at Risdon (Tasmania), but constructional work on the plant was to be continued. Severe dislocation of trade and industry with the heavy fall in metal prices led the company to this decision.

Clyde Valley Electrical Power.—Final dividend on the ordinary shares at the rate of 10 per cent. per annum for the half-year, making 7½ per cent. for the year. For 1919 a dividend of 5 per cent. was paid.

Chelsea Electricity Supply Co., Ltd.—Dividend of 7 per cent. per annum on the ordinary shares for the half-year, making 6 per cent. for the year.

North London Railway Co.—Net receipts for 1920 £160,234, against £165,143 in 1919. Dividend on consolidated stock 5½ per cent.

Telegraph Construction & Maintenance Co., Ltd.—Further dividend of 7½ per cent. announced.

Mather & Platt, Ltd.—Total dividend on the ordinary shares for 1920 at the rate of 10 per cent. per annum, free of tax.

Crossley Bros., Ltd.—Final dividend on the preference shares is announced, but no further distribution on the ordinary, which received an interim dividend of 3 per cent. for the first half. £51,161 carried forward.

THE BROWN-BOVERI MERCURY ARC RECTIFIER FOR LARGE OUTPUTS.

By R. L. MORRISON, A.M.I.E.E.

(*Concluded from page* 219.)

Short Circuits.—Though short circuits inside the rectifiers are now very rare, it is interesting to know of the difficulties that were experienced in this respect, and the steps taken to eliminate them. It was at first found that there was the liability of short circuits occurring if the pressure was raised above 220 volts, and for some time all the efforts that were made to overcome this tendency proved futile. However, after careful and prolonged investigation a design was gradually evolved in which it has been proved by years of experience that the risk of short circuits is almost negligible. The main causes that were found to be responsible for these occurrences were—condensed mercury running down the surface of the anodes, the effect of ultra violet rays, contact between the anodes and the negative flame already referred to, insufficient vacuum, and continuous abnormal overloading.*

The effects of the first three have been so far eliminated that the possibility of anything of this nature occurring is no more than what might be expected in any other form of electrical plant. The fourth point—insufficient vacuum—has been largely met by the provision of a very satisfactory type of air pump which ensures that the user is fully safeguarded in this respect. Furthermore, it is to his interest to keep the vacuum at a higher level because not only does it improve the overload capacity of the rectifier, but it reduces the drop in the arc, and hence improves the efficiency.

Dealing now with continuous abnormal overloading—the extent to which one can go is governed by the limiting temperature permissible at the anodes, in the same manner that temperature rise fixes the overload capacity of any type of machine. If the temperature of the anodes were allowed to exceed the safe working limit, the valve action would cease. The current would then flow in both directions, this constituting a short circuit. In practice, such contingencies are fully covered by the provision of suitable protective gear.

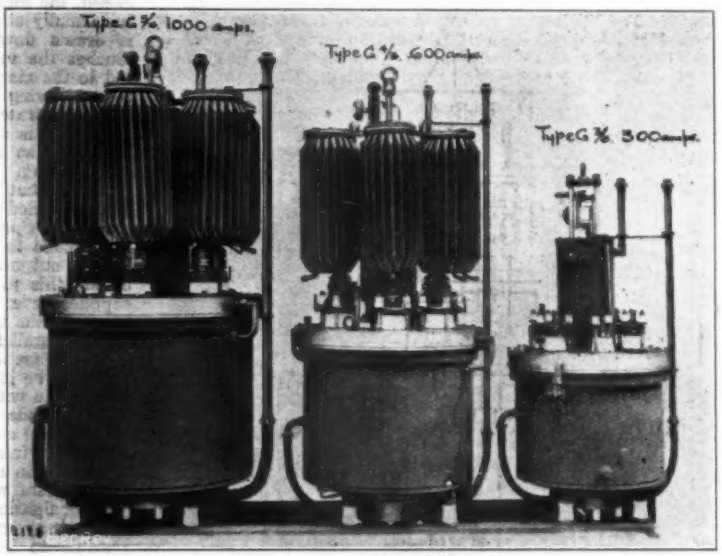
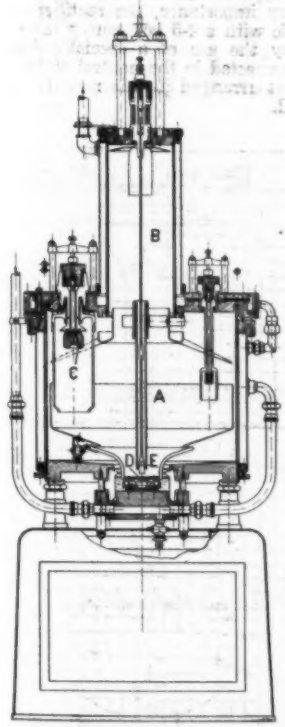


FIG. 9.—RECTIFIERS RATED AT 1,000, 600, AND 300 A.

Rating.—From what has already been said it will have been gathered that the rating of a rectifier must be governed by the current-carrying capacity of its anodes, and it is on this basis that three sizes have been standardised for dealing with 300, 600, and 1,000 amperes normal continuous rating (fig. 9). The same design can be used for any pressure up to 750 volts, and with small modifications up to 1,500 volts, while tests indicate that 3,000 or even 5,000 volts is not impossible with perfect safety—in fact the problem is much easier of solution with the rectifier than with the rotary converter.

With these higher pressures it is necessary to reduce the current rating somewhat, and to space the anodes rather further apart. The reason for the current being reduced is not very definitely known, for though a greater pressure drop in the arc has to be contended with, due to increasing the distance between the anodes, yet it is believed that the physical features of the arc play a more important part than is at first apparent. It will be realised that the potential difference between opposing anodes may be nearly double the working pressure, and as this is increased, the tendency to "back firing," as it is called, is also increased, and means must be adopted to keep such tendencies within limits. This "back firing" is probably due to the overcrowding of the molecules when excessive currents are handled. As the potential difference is increased, a point may be reached when some of the unionised gas particles are driven from their path and come near enough to the opposing anodes to be attracted to the positive ions coming from that anode. The resulting impact splits up the particles, and if the newly formed positive ions take the wrong path and come into contact with the opposing anode, cathode spots will be started on that anode. These spots will throw out elec-

* See *B.B.C. Review*, No. 6, 1919.



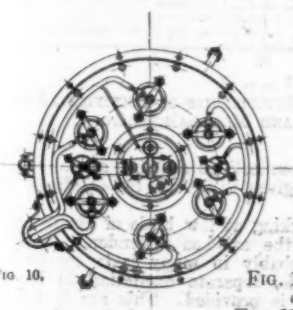
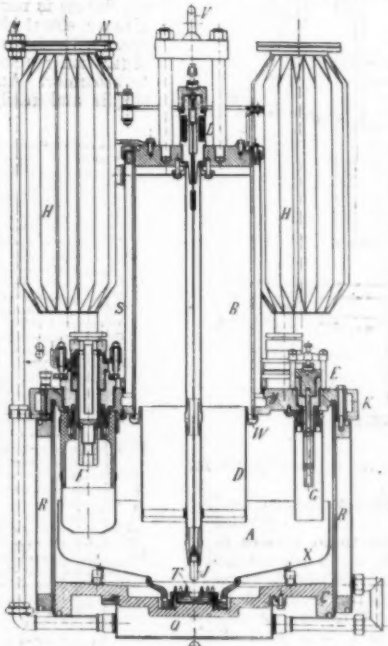


FIG. 10.



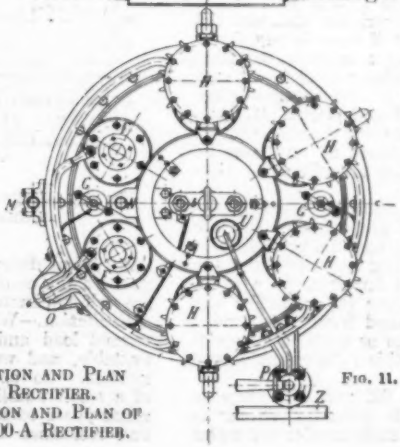


FIG. 11.

FIG. 10.—SECTION AND PLAN OF 300-A RECTIFIER.
FIG. 11.—SECTION AND PLAN OF 600 AND 1,000-A RECTIFIER.

trons which split up the neutral particles in the vicinity of the anode, thus creating fresh positive ions which travel back to the anode and increase the size of the cathode spots. This process would continue until the valve opened and a short-circuit would ensue. The simplest way of avoiding such occurrences is to reduce the current rating of the anodes as well as spacing them somewhat further apart.

There is practically no limit to the output that can be dealt with by rectifiers by operating two or more cylinders

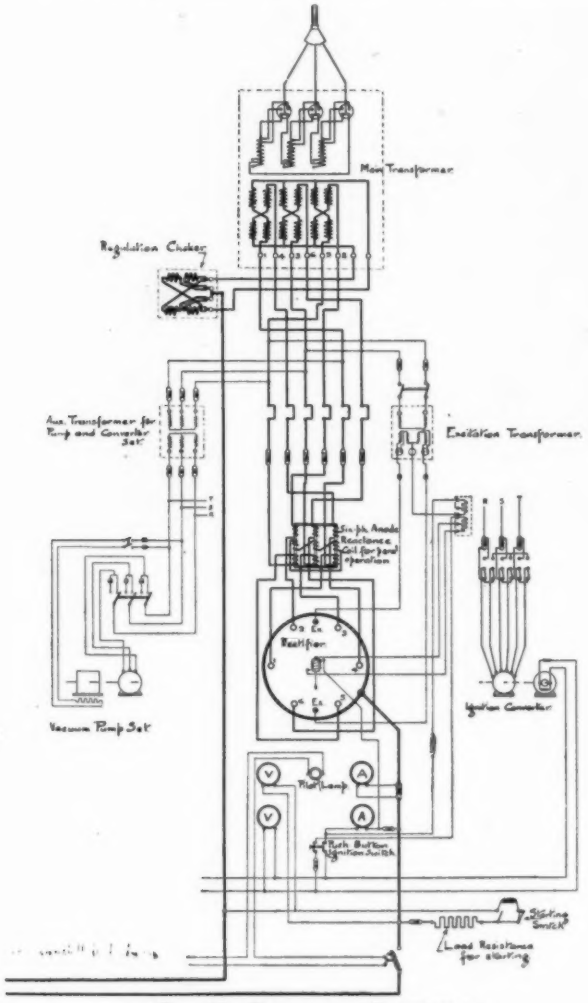


Fig. 12.—Diagram of Connections.

in parallel, with a common transformer or a transformer for each cylinder as the conditions dictate.

Fig. 10 shows a section through a Brown, Boveri rectifier with a normal rating of 300 amperes. The arc operates in the large lower chamber A between the main anodes C, of which there are six, and the cathode D, while the ascending vapour is condensed in the narrow upper cylinder B. Cooling is provided by water circulating through the jacketing round both sections of the rectifier as well as through the cathode base and the anode plate, which is the hottest part of the rectifier. Ordinary town water is invariably suitable, the quantity required being very small, but if there is any doubt as to its purity it is advisable to utilise a separate recooling system consisting of a number of radiator coolers through which the water is circulated, either on the thermo-siphon principle or by means of a ½-h.p. centrifugal pump. If, however, one pole of the system is earthed or the pressure exceeds 600 volts, the recooling arrangement must in any case be provided to eliminate as far as possible the effects of electrolysis.

The main anodes are completely encased by specially designed leading-in insulators and steel arc guides. The arc is thus confined to a well-defined path, and the possibility of direct short-circuits across the intervening space between the anodes is eliminated. These arc guides terminate in a cylindrical steel dish placed immediately above the cathode. The anodes, which are of special close-grained iron, are rounded and highly polished to remove all ridges or particles of metal from the surface, as irregularities of this nature would tend to produce short circuits.

The larger rectifiers for dealing with 600 and 1,000 amperes are depicted in fig. 11. The design is generally similar to that already described except that the main anodes are water cooled by means of the radiator coolers H. With the smaller cylinders the heat generated at the anodes can quite easily be dissipated through the leading-in insulators to the water cooled anode plate, and by radiation to the interior of the cylinders.

The arc is started by the ignition anode J which is connected to the iron core of the solenoid L by a long rod passing down the centre of the cylinder. The ignition current is provided by a small 110-volt converter. The connections are so arranged that, when the ignition push button switch is closed, the solenoid is energised and the ignition anode, which is normally about 10 mm. above the surface of the mercury, is drawn down against the pressure of a spring until it touches the mercury. The current then flows through the rod to the mercury—thereby short-circuiting the solenoid coil, thus allowing the spring to push the core upwards, which again separates the ignition anode from the mercury. A small arc is started at the point of rupture, and within a second or so sufficient vapour is formed to start the main arc working. The whole operation is extremely simple, and rectifiers that are in continual use can often be started up and paralleled on to the bus bars within a few seconds.

Parallel Operation and Regulation.—Reference has already been made to rectifier units operating in parallel to obtain higher outputs than are afforded by single cylinders. To enable this to be done in cases where a single transformer supplies several units, six-phase anode reactance coils are placed in the anode circuits, these coils also serving to ensure correct parallel operation with converters of other types. By variously connecting the windings any desired inherent regulation can be given. In some instances each rectifier cylinder is provided with its own transformer, and under such circumstances anode coils can be generally dispensed with.

The direct current voltage is controlled either by step-by-step regulation from the primary side of the transformer or by an induction regulator hand or automatically operated. The arrangement with the induction regulator is decidedly preferable for lighting supplies, as the voltage can be varied smoothly and to any extent, and when automatically controlled it is possible to leave the sub-station largely unattended, thus effecting a considerable saving in the matter of attendance. For the case of traction supplies, and where the question of regulation is not of primary importance, the rectifier can be given a shunt characteristic with a 4-5 per cent. rise of pressure with falling load, by the use of a specially designed regulation reactance coil connected in the neutral of the main transformer. An equipment arranged in this manner is very simple and easily operated.

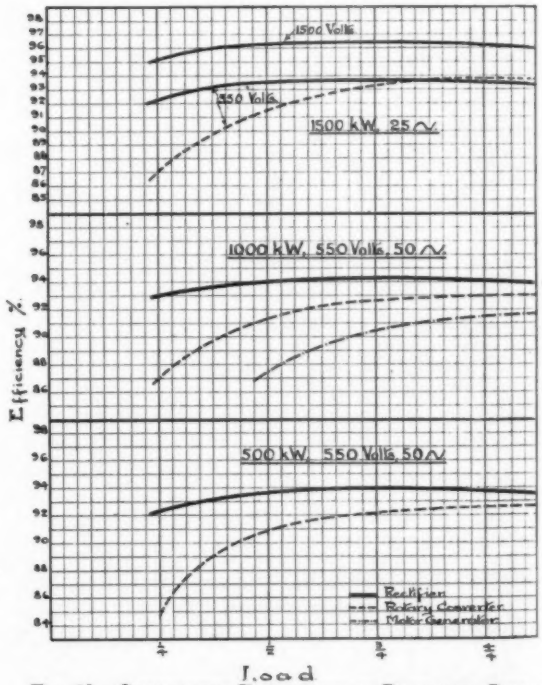


Fig. 13.—Comparative Efficiencies of Rectifiers, Rotary Converters, and Motor-Generators.

A typical diagram of connections showing all the auxiliary gear usually employed is given in fig. 12, the details of which are self-explanatory.

Excitation.—When working at low loads of about one-fifth normal load and below the arc has a tendency to become unstable, and would probably in many instances be extinguished. To obviate this, separate excitation in the form of a small auxiliary arc is provided. This arc is fed by a single-phase exciting transformer connected through a choker and resistance to the two small anodes G seen in fig. 11.

With highly fluctuating loads such as traction, rolling mills, &c., the excitation is kept permanently in circuit; the consumption represented is less than ½ kW per cylinder.

Vacuum.—One of the most important items of auxiliary gear provided with large rectifiers is the vacuum pump set for maintaining the high degree of vacuum essential to satisfactory operation. The vacuum required under normal conditions is about 0.01 mm. Hg. The drop in the arc, and hence the efficiency, is directly proportional to the vacuum which reaches a very high figure (in some cases as much as 0.005 mm. Hg) after the plants have been in operation for some time. These conditions are brought about by a highly efficient two-stage mercury air pump consuming about 1 kW when in use. The vacuum is measured by a very accurate and reliable form of gauge which is calibrated to give direct readings of the vacuum. With this gauge distinct readings of pressure differences as small as 1×10^{-6} mm. Hg. can be made. The gauge is mounted in an iron pillar to prevent breakage. If desired, the rectifiers can be provided with electrical vacuum indicators, the voltmeter portion of which is calibrated to give direct readings of the vacuum, and can be mounted in any convenient position, such as on the switchboard.

Efficiency and Power Factor.—It has already been shown that the efficiency of a rectifier remains constant at all loads. To obtain the over-all efficiency, however, account must be taken of the losses occurring in the main transformer and auxiliary gear. Curves have been plotted for various sizes of units in fig. 13, and for purposes of comparison those applicable to rotary converters of equivalent output are also included. It will be seen that the over-all rectifier efficiencies remain practically steady down to nearly ¼ load when the constant losses, such as the transformer iron loss, begin to be felt and the curves commence to fall. The results are, on the whole, a good deal better than those obtained with the rotary converter, and would improve in course of time, due to the better vacuum that would obtain. In this respect it might be said that the value of a rectifier appreciates instead of depreciating as with other converters.

For the higher traction voltages of 1,500 and upwards now coming into use, very high over-all rectifier efficiencies can be given. A curve for a 1,500-kW unit at this pressure is also indicated. In general the power factor varies between 90 and 97 per cent.

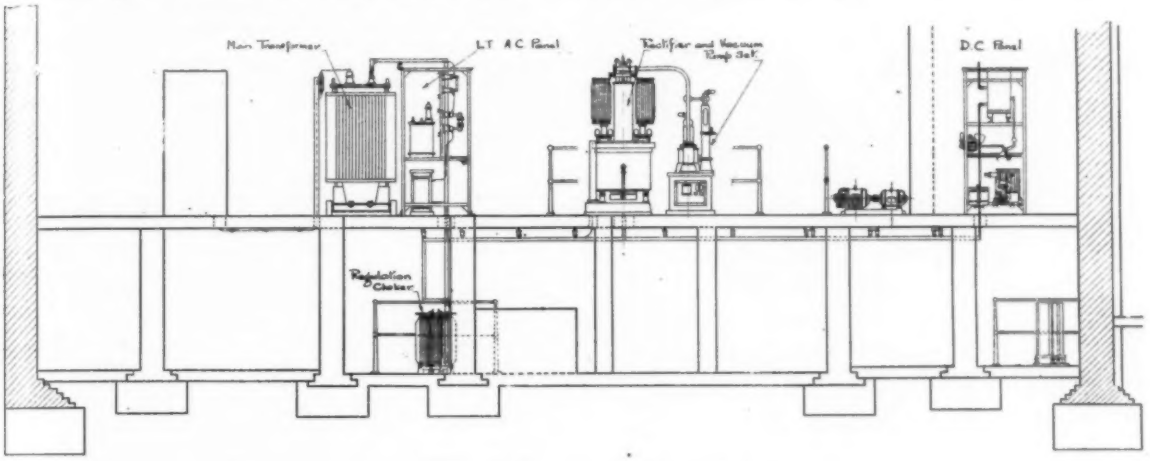
General.—In many respects the mercury arc rectifier is decidedly superior to all other forms of converting plant. In the matter of efficiency there is no question of its superiority, except perhaps at low direct current pressures. It is entirely reliable in operation under all conditions, and requires no highly skilled attention. In this connection it might be said that automatic operation by remote control will probably be possible in the near future.

As regards weight—it is less than half that of a rotary converter of the same output at 550 volts, while the floor space required is in general a good deal less. There are no running parts, and in consequence little or no wear, this particularly applying to the rectifiers themselves. Due to the anodes and mercury operating in a high vacuum no oxidisation occurs, and for spares the makers merely recommend stocking a few insulators and fuse elements.

No converter is so capable of handling highly fluctuating loads as the rectifier. It is insensible to short circuits of short duration, but prolonged ones must naturally be cleared by suitable protective gear.

Frequency has no bearing on its output or operation, and has only to be taken account of in the design of the transformer and auxiliary gear. It is thus possible to couple rectifiers in parallel when supplied with current at different frequencies.

In operation the rectifier proper is noiseless, and sub-stations can with impunity be erected in crowded areas without the locality being aware of the existence of converting plant



Layout of 600 Ampere Rectifier with Transformer and Switchgear

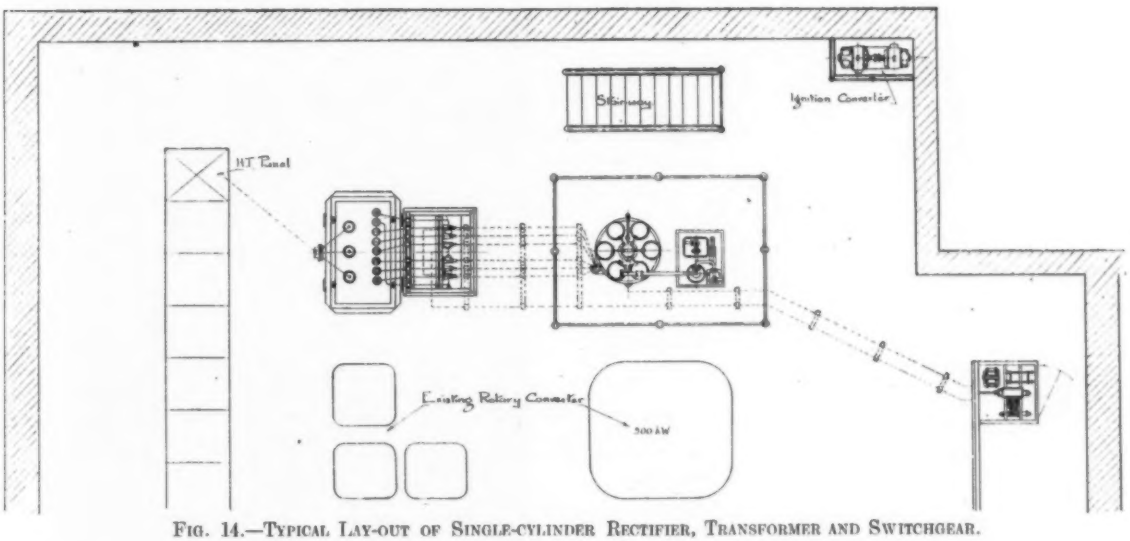


Fig. 14.—Typical Lay-out of Single-cylinder Rectifier, Transformer and Switchgear.

in their midst. To illustrate the possibilities in this respect it might be stated that one set at present on order will probably be placed in the basement immediately below the supply company's show-room.

For high-pressure direct-current traction there is no doubt the rectifier will find an extensive field of application. Several sets have already been installed on the Continent for this class of work at 1,100 and 1,200 volts, and others are in prospect, while pressures up to 3,000 volts will eventually be dealt with.

The lay-out of rectifier plants is a very simple matter. In fig. 14 is depicted one for a small set to be installed in this country. It will be noticed that no special foundations are

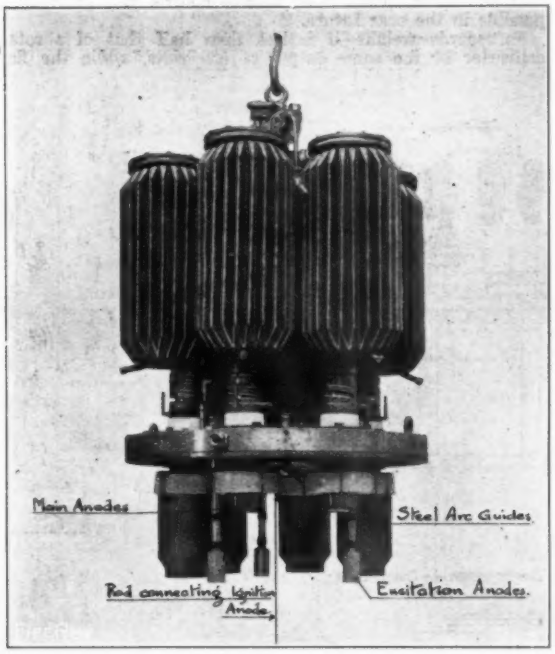


Fig. 15.—Top Half of Large Rectifier (Arc Chamber Removed).

provided, the only requirement in this respect being that the floor should be level and strong enough to take the weight of the plant. In this respect alone, apart from all other considerations, the saving effected is quite appreciable, and when a new sub-station is required a much lighter design can be adopted than would be the case if a rotary converter was under consideration.

Up to the end of 1920 the total number of rectifier sets either installed or on order was 134, the aggregate output of which is 53,000 kW. Having regard to the comparatively short time the Brown, Boveri rectifier has been commercially manufactured, the manner in which it has been taken up is very gratifying, especially when one considers the large amount of spade-work that had to be done.

In conclusion, the author desires to express his thanks to Messrs. Brown, Boveri & Co., Ltd., and Power-Rectifiers, Ltd., for giving him the facilities and materials upon which this article has been based.

THE SEVERN BARRAGE SCHEME.

On February 10th and 11th a joint meeting was held in Birmingham of the Institutions of Civil Engineers, Electrical Engineers and Mechanical Engineers to discuss the Severn Barrage scheme, and particularly the third interim report of the Water-power Resources Committee. A large gathering attended both meetings. The chair was occupied by Mr. J. D. Watson, M.Inst.C.E. (President of the Birmingham Association of the Institution of Civil Engineers), who was accompanied by Mr. F. Forrest, M.I.E.E. (chairman of the South Midland Centre of the Institution of Electrical Engineers), and Sir Gerald Muntz (representing the Institution of Mechanical Engineers). In introducing the subject, Mr. Watson said the Severn Barrage scheme had been thrust upon the public by a fanfare of trumpets in a manner suggesting political stage management; the subject was intensely interesting, the more so perhaps because it was fraught with many difficulties.

The discussion was opened by Mr. R. A. Chattock, M.I.E.E. (chief electrical engineer to the City of Birmingham), who summarised the particulars which had been published by the Ministry of Transport and the Water Power Resources Committee, and then went on to discuss the financial possibilities of the scheme. The Ministry of Transport scheme mentioned one million h.p. with an average of half a million h.p. over a 10-hour day. The Water Power Resources Committee mentioned an average of 260,000 kW over a 10-hour day, and he took the latter figure as a basis for calculation. The average efficiency of the Ministry of Transport scheme would be about 63 per cent. from the brake-horse-power on the barrage turbine shafts to the overhead transmission lines. Working back from this, it was obvious that the capacity of the generators at the barrage should be 476,000 kW. Taking this figure as a basis, he had estimated that the cost of the necessary electrical machinery would be £17,707,000. This was far too high; he therefore put forward a suggestion to use constant-current d.c. generators in place of constant-potential generators, and to run them in series on the Thury system. The average efficiency of this scheme would be about 62 per cent. from the barrage turbine shafts to the transmission lines, and the scheme would require a generator capacity at the barrage of 456,000 kW. The cost of the electric plant, exclusive of foundations, buildings, &c., in this case, would be, he estimated, £11,938,000. Mr. Chattock also estimated that on the basis of electrical machinery only energy would cost on the Ministry of Transport scheme 0.544d. per unit, and on his suggested scheme 0.369d. per unit. It appeared probable that the cost of other sections of the work would be far heavier than the cost of the electrical equipment, and in order that the whole question might be properly gone into, he welcomed the suggestion of the Water Power Resources Committee that the Board of Trade should appoint a Special Committee of Inquiry to undertake the necessary investigations.

Prof. F. C. Lea, D.Sc., M.Inst.C.E., discussed in detail with the aid of diagrams the complex tidal variations which occurred in the Severn, and described the geological features of the site. In his opinion, before decisions were made it was necessary that careful hydrographic surveys and records should be made, particular attention being given to the problem of silting, and that the geology of the district should be carefully examined. Data were required concerning the daily and the 14-day variations of the tide, and if a reservoir was decided on, its proposed capacity should be considered in relation to both these tidal variations, which were by no means constant. The turbines should be capable of working efficiently at heads varying from 6 to 36 feet. The whole scheme was worthy of consideration, but in view of the large

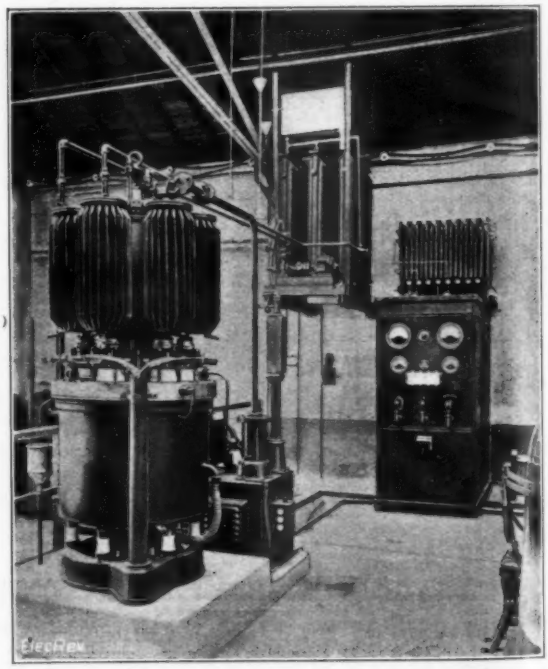


Fig. 16.—300-kW, 600-V Rectifier and Switchgear at Asnieres (Paris).

capital expenditure which would be involved, and the possible cost of removing silt, and loss to vested interests, the scheme should be thoroughly examined before any policy was decided upon.

Mr. J. W. Twinberrow, M.Inst.C.E., after outlining the history of tidal power utilisation, and particularly proposals relating to the Severn, described the scheme which he had submitted to the W.P.R. Committee. Referring to the scheme which had recently been published by the Ministry of Transport, he said that on February 24th, 1920, he and his collaborators were advised by the chairman and secretary of the

Water Power Resources Committee that the Ministry of Transport, having seen their interim report, was asking to be supplied with a copy of their evidence; they also suggested that they should attend a conference with the committee and the Ministry of Transport. On February 28th they agreed to both suggestions. On March 11th, 1920, they attended the conference, the Ministry of Transport being represented by Sir Philip Nash and Sir Alexander Gibb. Their projects were then explained, and another meeting with the Ministry's engineers was fixed for March 19th, 1920, at which their proposals were further explained. The meeting ended with a discussion of the next steps to be taken. Their opinion, as already explained to the Water Power Resources Committee, was that further elaboration of designs and details was superfluous in view of what they had already done, but that:—

1. The geology of the Severn Tunnel and Beachley sites required careful expert investigation supplemented by borings or trial holes.

2. Tidal gauges should be set up at both spots and continuous records kept thenceforward.

3. Samples of the water should be taken from all points of the estuary and at all states of the tides with a view to ascertaining the quantity of silt in suspension and its rate of deposition. Also that the probable action of the silt on the runners of the turbines should be investigated.

4. A geographical survey should be made of the highlands within a large radius in order to establish beyond doubt whether better sites for reservoirs existed than those they had chosen near Tintern, or not.

5. The vested interests in the neighbourhood should be ascertained, and the probable effect on them of the altered regime of the river should be carefully investigated.

6. The question of high-pressure generators and transformers working in the particularly humid atmosphere of the estuary should receive attention.

7. A fresh survey of the estuary should be made.

Mr. H. P. Raikes, M.Inst.C.E., said that as a civil engineer, who had for many years had occasion to study the tidal currents of the Bristol Channel, he could not too strongly emphasise the need for further investigation. About 14 years were occupied in driving the Severn tunnel, when immense difficulties were encountered owing to the great springs met with. If it was only found economical to draw off the water down to about half-tide level or ordnance datum, then the silting-up of the estuary might become a very difficult problem. The dam could no doubt be utilised to carry a road and railway across the river, but the economy of this seemed likely to be largely counterbalanced by the extra cost of constructing a dam to serve the double purpose. He thought all would agree in deprecating the manner in which the scheme had been introduced to the public by the Ministry of Transport without any engineering evidence of its practicability.

Mr. F. W. Macauley, M.Inst.C.E., referring to the proposed dam for the reservoir up the Wye valley, said that the proposed site was in a limestone formation. He did not think that any engineer would take the responsibility of impounding water, especially brackish water, on a limestone formation. Mr. Twinberrow had foreseen this, and had said that it was suggested to make the reservoir of the lined type; that was an infinitely more expensive method of construction. A very great amount of careful investigation was absolutely necessary before it could be said that the barrage and the reservoir were feasible.

Mr. F. H. Clough, M.I.E.E., said that with the assumptions he had made, a rough estimate of the cost of machinery, switchgear, and transmission lines came to about £20,000,000, and he had assumed that the capital charges on this money should be taken as 15 per cent. (based on 15 years' life), so that the annual capital charges would be £3,000,000, and if this was based on a continuous output throughout the 24 hours of 150,000 kW the price per unit due to this capital charge would be 0.67d. The civil engineering he had only guessed at, and put down the figure of £10,000,000. Allowing a capital charge of 7½ per cent., based on 50 years' life, the cost per unit would be 0.17d. for 150,000 kW load, and proportionately higher for smaller loads. The capital charges on the machinery, which formed the bigger figure, would remain approximately constant whatever the load, being proportionate to the amount of load developed, and if the machinery cost, as would seem to be the case in this scheme, was the greater cost, then it would seem possible, if the barrage were built, to develop the more expensive part of the scheme gradually as the demand warranted it, or as money could be obtained. In this respect the scheme differed from many water-power schemes where the whole capital expenditure must be incurred before any power could be delivered. In speaking of the technical side of the scheme, Mr. Clough referred to the tidal irregularities in the Severn, and suggested that these might be due to a "resonance" effect. It was important,

A Severn Barrage Scheme of 1843.

The idea of damming the Severn is at least a century old. About 1818 the Gloucester and Berkeley Canal Co., being unable to raise capital to complete the canal, requested the Government to advance the necessary funds. Telford was instructed to examine the scheme, and on the strength of his report the Government provided the money, appointing him as engineer to see that it was properly expended. There is a tradition that whilst he was engaged on this work he proposed to erect a barrage at Beachley; but no details have been left on record. About 1843 Mr. Fuljames, an architect and county surveyor, took up the matter, and prepared the water-colour drawing which, thanks to the courtesy of Mr. Cullis, engineer, Gloucester Dock Co., and Mr. Addenbrooke, we are enabled to reproduce; it will be seen that it comprises all the features of the latest proposals except, of course, the installation of turbines. Evidently the scheme was too expensive, for Mr. Fuljames applied to the Admiralty in 1845 for permission to carry a high-level bridge across the estuary at the same place; Mr. Walker, a leading civil engineer, reported on the scheme, and permission was granted, but nothing came of it. Mr. Fuljames's petition and Mr. Walker's report have been found in the archives of the Institution of Civil Engineers.

therefore, to inquire whether this effect would be materially modified by the barrage, as this might have an important bearing on the calculated performance of the machinery which it was proposed to install.

The proceedings on the second evening of the discussion were opened by Mr. G. L. Addenbrooke, M.I.E.E. In dealing with the history of the Severn scheme, he said the public were chiefly acquainted with the project through the proposals which were blazoned forth at the end of last November by the Transport Ministry, and in a less degree, and within a much more restricted circle, by the third interim report on Tidal Power by the Water Power Resources Committee, which was dated December 1st, 1920, but was not actually issued until two or three weeks later. The committee was appointed by the Board of Trade on June 20th, 1918, and Sir John F. C. Snell was chairman. It was desirable to remark that Sir John Snell was appointed chairman in his private capacity, and had remained chairman in that capacity since. He was appointed Chief Electricity Commissioner some six months later, but this was, so to speak, an accidental circumstance. The committee consisted originally of about 15 members. Five members were added later when the Government decided to include the question of water supply, as well as power supply, within the terms of reference. The first hearing before the committee was held on December 5th, 1918. It was impossible to deal with all the evidence at one hearing, and the matter was adjourned until May 29th, 1919. Two days later he and his colleagues received a letter from the secretary, stating that they had made out a *prima facie* case, but asking for certain further fundamental data to enable the committee to carry out independent calculations. A long series of correspondence and interviews with the secretary, and an interview with Prof. Gibson, extending over some months, followed this communication. On February 24th, 1920, they received a letter from Sir John Snell asking permission to place all their evidence at the disposal of the Transport Ministry. A Conference of the W.P.R. Committee and representatives of the Transport Ministry took place on March 11th, 1920, and was adjourned at Sir Alex. Gibb's suggestion to discuss matters further with him privately, the adjourned meeting taking place about a week later. Beyond the forwarding of a geological report, only two or three unofficial interviews took place between Mr. Addenbrooke and the Ministry of Transport during the next nine months, when, without a word of warning, the Ministry launched the now familiar proposal in the newspapers. More could be said on this disagreeable part of the subject, and what he said he had said with reluctance, believing it in the interests of the engineering profession that the facts should, at any rate so far, be publicly known. He did not think it was wrong to assume that should such procedure be repeated by Government departments, the confidence of independent engineers in placing proposals before them, either on their own behalf or on that of clients, would receive a rude shock. On behalf of himself and his committee, Sir John Snell authorised *The Electrician* a short time since to state that neither he nor his committee had any part in those proceedings. He thought it was due to Sir John and to the committee to take this opportunity of publicly thanking them for the patience and care with which they had investigated the somewhat novel proposals which were put before them, and to point out to the engineering profession, what an advantage it would be if there were some private tribunal of a more permanent character, before which engineers could place proposals connected with public utilities before incurring the vast expense and uncertainty of putting the matter to the test by private Bill. After outlining the scheme and giving extracts from a report to him by Prof. W. C. Unwin, Mr. Addenbrooke said that further inquiries, Parliamentary procedure, and the raising of the necessary finance, would almost certainly make it impossible that the first sod could be turned under four years. It would take at least another two years to get in the foundations of the barrage, and to get it up to a point where the final specification of the exact method to be used for electric generation need be absolutely settled. While, therefore, practical methods were available now there were six years at least in which these matters could receive further consideration.

Mr. N. B. Rosher, M.I.E.E., dealt with the problem of transmission to Birmingham, a distance of approximately 70 miles. If this could be shown to be economical, then the remaining transmission lines certainly would be so, as they were all very much shorter. The problem was how best to transmit a maximum load of 100,000 kW from the Severn barrage to the Birmingham district. On the question of cost, the advantage was heavily in favour of overhead transmission. The cost of a system of buried cables would be approximately four times that of an overhead system for the same section of copper. He suggested that two double-circuit lines should start from the generating station and be carried either together or preferably at a distance of several miles apart to two separate sub-stations, at points convenient for feeding into the systems in and around Birmingham and district. Supply could be given to towns and large consumers *en route*. Each circuit would transmit 25,000 kW, or 50,000 kW per tower line. The conductors would be spaced at 6-foot centres, three on either side of the tower. The towers would be steel structures approximately 65 feet high, and spaced ten to the mile or 525 feet apart. The clear height of the lowest conductor above the ground would be about 22 feet. At intervals of 20 to 25 miles switchgear would be provided so that in the event of a breakdown occurring on one circuit, the other circuit could take the load until repairs had been effected in the faulty circuit. There would also be changeover switchgear at both the generating and the receiving end. At present-day prices the advantage was with copper as against aluminium, and therefore a copper line had been assumed in his calculations. The load factor had been assumed to be 40 per cent. The total cost of two transmission lines capable of transmitting 100,000 kW a distance of 70 miles, and including two sub-stations with switchgear, step-down transformers, and induction regulators, he estimated at £1,000,000. Allowing interest at 7 per cent. and depreciation at 5 per cent., the capital charges amounted to £120,000. The units transmitted to Birmingham would amount to 350,400,000 per annum, therefore the capital charges per unit would be 0.081d. The units lost in the transmission line would be 35,000,000; assuming a generating cost of ¼d. per unit, this amounted to 0.05d. per unit. The total charges were, therefore, 0.131d. per unit, which had to be added to the assumed generating cost of ½d. per unit, making the price delivered into the Birmingham mains 0.631d. per unit. An addition of 0.16d. per unit should be made to cover the cost of distribution and supply to local consumers; the selling price would, therefore, be 0.791d. per unit, or, say, 0.8d. per unit. As the present average price of electricity sold in Birmingham and district was 2d. per unit, it would appear that from the figures given above the transmission of energy from the Severn barrage was justified.

Prof. F. W. Burstall, M.A., M.Inst.C.E., dealt with the generation of power from fuel, pointing out that it might be possible to generate power on a small scale at a cost very little higher than the wholesale production, and in that case any transmission system would involve not merely lost power but interest and depreciation. It was possible to obtain a h.p.-hour from a Diesel motor for something under 0.4 lb. of oil; taking oil at £10 per ton, that was 0.43d. per b.h.p.-hour. With the Crossley cold-starting solid-injection engine it was possible to get a consumption of 0.425 lb. per b.h.p.-hour, or a fuel cost of 0.45d. The gas engine using a solid fuel was under a very serious cloud, but there was running in Belgium an engine of more than 6,000 h.p. in four cylinders, so that the problem was not impossible. Speaking generally, the suction producer would give a b.h.p.-hour for about 13,000 B.th.u., or about 1 lb. of anthracite coal; at £3 per ton this represented a cost of 0.33d. He had during the past two years been making a considerable number of experiments in which Messrs. Crossley Bros., of Manchester, had greatly assisted him, towards solving the problem of increased economy by regeneration—storing up the heat of the exhaust in a chamber, and passing through this chamber the incoming air and steam to the producer, while the other half of the regenerator was being heated by the exhaust gases. Working in this manner he had been able to obtain a b.h.p.-hour for 0.7 lb. of coal put into the producer, a result which he thought was unequalled in the development of the heat engine. It would be deplorable if enormous sums of money were expended on schemes for the production of cheap power, and then it was discovered that still cheaper power could be obtained.

Mr. W. Willet, M.Inst.C.E., said that something was to be said in favour of constructing a road and railway viaduct first. The amount of water run off through the shoots to generate a maximum of 1,000,000 h.p. would be very large, and would cause a swift current in the comparatively narrow channel; this would render navigation very difficult and very deep lock gates would be needed. Possibly a short ship canal round one end of the barrage would be necessary to avoid this current. He thought the scheme was on the whole very desirable, and if successful would afford a stimulus to industry and production.

Mr. C. M. Shaw, M.I.E.E., said that at Worcester some 25 years ago the Corporation decided to harness the water of the Teme. Very great things were expected of the scheme in its early days, but they only realised about one-tenth of what should have been obtained. Vested interests had prevented the proper development of the water power. At Worcester the civil engineering cost might be put at 150 per cent. of the electrical section of the undertaking. The pumping station was to be situated some miles up the river Wye; assuming that the barrage was at or near the confluence of the Wye and the Severn, and the Wye was left in its present state, a vast quantity of water would have to be pumped, and he was inclined to think the result would be a reversal of the flow of the Wye at certain states of the tide.

Mr. H. C. Young, A.M.I.E.E., deprecated the whole scheme on the ground that the estimated saving of 2¼ million tons of coal per annum did not justify the heavy capital expenditure involved in the Severn barrage; it was but a small fraction of the 264 million tons annually raised in this country. If the Government would offer a prize of £1,000,000 to anyone who could show how the over-all efficiency of their coal consumption could be increased by 2 per cent., it would be a much less costly expenditure than that proposed, and would result in a greater saving of coal.

Prof. W. Cramp, D.Sc., M.I.E.E., dealt with the subject from the point of view of the consumer. At Walkerburn on the Tweed there was a waterfall of 12 feet, which a certain firm had been using for about 60 years past. Recently the scheme had been extended so as to provide for pumping the

water in the night hours a height of 1,000 feet to storage, in order to double the h.p. capacity of the installation. This had cost £100,000; and on this basis he arrived at an outlay of £50,000,000 instead of £40,000,000 as an estimate of the cost of the Severn barrage scheme. The interest and depreciation alone on such a large outlay would be very heavy, and the price per unit at which the energy could be sold was not much better than 1½d. per unit, under the best conditions. Was it necessary for the scheme to provide for such large storage as would enable the maximum power to be given day and night all the year round? It should be possible to make arrangements in the large centres of industry, and possibly with large individual customers, to install storage batteries to give them such energy as they might require during the periods when they were not having the full direct load, and it might pay the Government to make allowances, or even pay for such storage batteries, rather than build enormous reservoirs. He did not think the Severn barrage would hold water.

Mr. W. Wilson, M.Sc., A.M.I.E.E., speaking from experience of successful hydro-electric schemes in distant parts, said he had not known a single hydraulic scheme to be a failure. The Severn scheme should be given their most favourable consideration from a national point of view.

Mr. F. J. Moffett, B.A., M.I.E.E., said that if they were going to make an experiment, they should make it on a small scale. There were several tidal basins round the coast which could be used for the purpose. He instanced a piece of land, about 800 acres, which had been reclaimed by a sea wall; recently the sea had made a breach in the wall, which could be used for the construction of an experimental power house. There was 700 b.h.p. available for four working periods of 2½ hours each per day. The units developed per annum would be 150,000,000; the capital cost was £350,000. Taking interest and depreciation at 10 per cent., representing £35,000, and estimating that 120,000,000 units would be utilised, that would amount to a charge of about 0.7d. per unit, to which must be added transmission and distribution losses. Even with those additions, the energy could still be supplied at something like a penny per unit, and that in the South of England would be quite a moderate price.

Dr. Gisbert Kapp said the suggestion had been put forward that the idea of a hydro-electric station should not be dismissed merely on the ground of expense, but it was important in considering such a station to be clear in their minds of certain difficulties. He was, at first, much impressed with the idea put forward in favour of the Thury system, but on closer consideration he believed the system to be impossible.

Mr. Addenbrooke, in replying on the discussion, said he would like to say that as designers they put the whole matter before the Water Power Resources Committee for investigation. They had not said that the scheme was practicable or not, they had simply said that as far as their figures went the matter was worth inquiring into further. The report of the Water Power Resources Committee showed that practically it had taken that view. It was most unfortunate from many points of view that the Transport Ministry should have dragged this sort of red herring across the trail in almost every direction.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New "Tricity" Oven.

The British Electric Transformer Co., Ltd., 50, Oxford Street, W. 1, has recently added a new oven to its range of apparatus. This oven, which is made in two sizes, is illustrated in fig. 1. The construction is of sheet steel with cast-iron door, frame, front, sole plate, top, and feet. The oven is double-walled and lagged with slag wool. The loading of the smaller size is 1,500 watts, while that of the larger is 2,000 watts. The controls in the case of the 1,500-watt

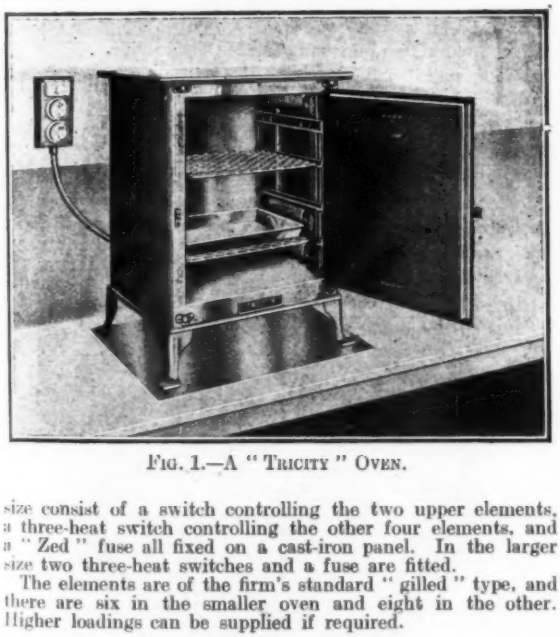


Fig. 1.—A "Tricity" Oven.

size consist of a switch controlling the two upper elements, a three-heat switch controlling the other four elements, and a "Zed" fuse all fixed on a cast-iron panel. In the larger size two three-heat switches and a fuse are fitted.

The elements are of the firm's standard "gilled" type, and there are six in the smaller oven and eight in the other. Higher loadings can be supplied if required.

A Universal Current Limiter.

A universal current limiter, sold by Messrs. Marshall and Plumtree, 20, High Holborn, W.C. 1, consists of a two-pole electro-magnet having a balanced centrally pivoted armature rocking between the poles. Should an excess current flow the armature lifts the flicker switch lever (which is normally detached from the armature), thus giving a quick make and break. This operation is repeated until the current in the lamp circuit falls to its contract value.

Amongst the advantages claimed for the device (fig. 2) are: The same limiter can be used on either d.c. or a.c. circuits; the switch contacts being made of gold-silver alloy remain clean in working for an indefinite period. This method dispenses with the use of mercury, which has been found to be very troublesome for this class of apparatus; the instrument can be set to operate at any current between .4 and 1 amp., the adjustment being spring controlled and regulated by means of a locking screw. The spring being made of nickel silver is non-rusting; the insulation is shellacked mica, and every instrument is tested for insulation at 500 volts pressure after manufacture; sealing is properly provided

Fig. 2.—A Universal Current Limiter.

for at each cover screw, and the limiter is absolutely proof against outside tampering or unauthorised interference when once fixed; the limiter is very simple and accurate, quite sensitive, and will operate with a small load increment over the pre-determined value.

Martin's Feedwater Oil Gauge.

It is often important to be able to ascertain the amount of oil entering a boiler with the feedwater. Whatever method is used for doing so, means should be provided whereby it would be possible at all times to check the efficiency of the system, and judge the result of any adjustment that might be made in the working arrangements. It was to meet the above-mentioned conditions that the simple "gadget" known as Martin's feedwater oil gauge was introduced whereby the amount of oil mixed up in the feedwater in the finely-divided state that forms an emulsion can be accurately measured in a few seconds. The device consists of a glass tube with a closed bottom of white porcelain; in the centre of the latter is a conspicuous black spot, and on the outside of the tube suitable graduations are engraved. When using the instrument the feedwater to be tested is poured slowly into

the tube while the black spot is observed through the liquid; as soon as the spot is on the point of becoming invisible, when held in a good light, the height of the column of liquid is read off on the scale. This gives the number of grains to the gallon, or milligrams to the litre if the decimal scale is preferred. The gauges are made in three sizes: "A" indicates from 1 to 10 grains; with "B," which is about double the length of "A," quantities down to 0.5 grain can be read off, and by using size "C" it is possible to detect as little as 0.25 grain per gallon. The makers of the gauges are Messrs. F. A. Pullen & Co., of the Empire Works, Vauxhall, S.E. 11.

The "Baby Paragon" Switch.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham, has produced, at a very reasonable price, a small but strong and efficient 10-amp. switch. The "Baby Paragon" switch (fig. 3) is designed to take the place of tumbler switches where these are too weak to stand up to the work required of them. It is made on sound engineering lines, each pole is mounted on a separate base of best English porcelain, and the blades are rigidly clamped over

Fig. 3.—The "Baby Paragon" Switch.

mica insulation on to a metal bar. This bar involves no risk of distortion which is often found in fibre bars. A threaded detachable gland can be employed for conduit systems or the switch can be used on ordinary "flexible" circuits. An interlocking arrangement with a side handle prevents opening while the switch is in the "on" position. This little switch will be found very useful on cooking, heating, and small power circuits. The M.E.M. Co. is bringing out a number of variations on this design, both double and triple-pole with arrangements for fuses.

The "Lightning" Cooking Oven.

Ten years ago, Mr. Napier Prentice invented the "diving-bell" type of oven, and proved its efficiency; it has since been under continual observation, and has demonstrated its reliability. We recently inspected the latest pattern, which, under

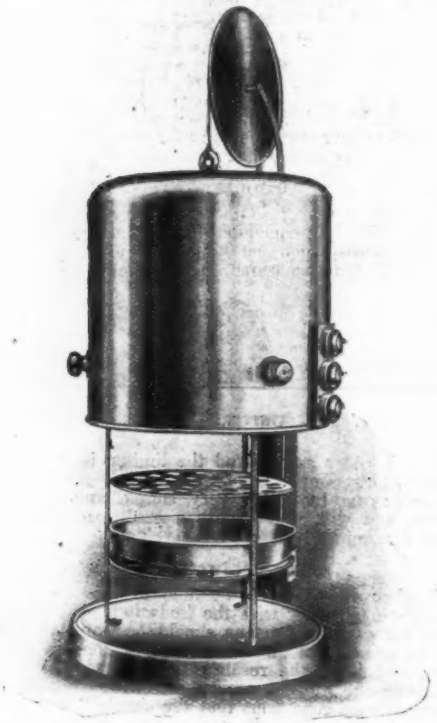


Fig. 4.—The "Lightning" Oven.

the name of the "Lightning" oven, has been developed by Electrical & Engineering Development, Ltd., and can be obtained from the manufacturers, Messrs. Electrical Utilities, Ltd., 1 to 3, Shelgate Road, Battersea Rise, S.W. 11.

As shown in fig. 4, the oven consists of a double-walled sheet metal dome (with lagging between the walls), suspended from a pulley which is carried by a standard attached to the metal base, a counterweight being provided so that the dome can be raised with ease. Inside the dome is the heating element, which consists of a simple spiral of resistance wire wound on a frame, as shown in fig. 5, the whole, with the switches, being attached to the dome, but readily removable. The connections are made through a flexible conductor, leading to a terminal box on the standard. A light framework attached to the base carries shelves for baking-dishes,

Fig. 5.—Frame and Heating Element.

&c. This type of oven has the advantage that the heating element surrounds the food, and can be run red-hot; when the dome is raised, the hot air remains inside it without much loss of heat; with three switches, five heats are obtainable; there is little metal to heat up, so that the oven quickly attains a cooking temperature; and the efficiency is very high, as shown by tests which we reported in our issue of September 19th, 1913, when Mr. W. H. Alabaster, in Melbourne, tested 12 types of oven, and found that an oven of this type reached the working temperature in five minutes, and was maintained at that temperature with 300 to 230 watts, whilst the majority of the ovens tested required 750 to 600 watts to maintain the temperature. Hence it is claimed that this oven will effect a great economy. It is finished either with a spun aluminium or enamelled steel dome.

A New Voltmeter Switch.

The Park Royal Engineering Works, Ltd., of Cumberland Avenue, Park Royal, London, N.W. 10, has put on the market a new voltmeter switch which has distinctive and attractive features. Users of voltmeter switches know that the most common and most troublesome failures of these switches arise from imperfect contact due to dust or damp; to overcome these troubles the "P.R." switch, fig. 6, is

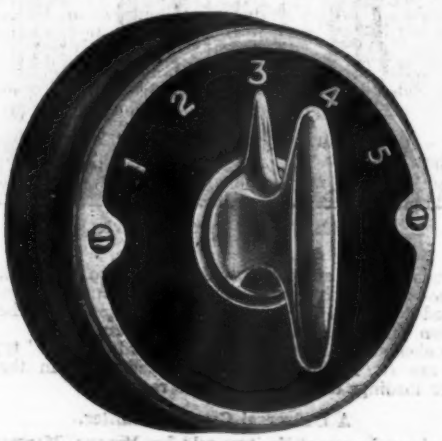


Fig. 6.—P.R. Voltmeter-Switch.

totally enclosed in a steel case, with an external operating handle. The case is finished in black and nickel to match the P.R. instruments, and has a handsome appearance. The operating handle has a pointer which comes to rest sharply and definitely at each number. The switches are made in two sizes—3-way and 5-way—and are double-pole. The contacts are embedded in "Hightensite" insulation, thus ensuring an excellent pressure test. The movement is controlled by a combination of ball, socket, and spring, which gives a smart, definite action. From a sample which we have before us, we should class this device as A1 in quality.

THE STABILITY OF CONTRACTS.

Mr. Hugo Hirst, of the General Electric Co., Ltd., in speaking on the subject of "Stability of Contracts a Necessary Factor in Industry," at a conference organised by the Industrial League and Council, and recently held at his residence, Fox Hill, Reading, said:—

Most of them refused to take part in discussions on economic subjects before the war. Now they had got to learn all there was to be known, and the only way to learn was by contributing to the common pool the results of their experiences. Such facts as he would be able to put into the pool were still open to doubt in his mind, because he had not heard everything that was to be said on the subject.

He did not quite know whether the real title of the paper submitted by Mr. Petter was sanctity of contracts or stability of contracts. Both words had been used. He would rather proceed on the lines which he would describe as stability of contracts. If he recollected aright, his friend Mr. McKenna said what they wanted was stability of prices. They had also heard it said that food was the basic value of all things. How could they stabilise prices if prices depended on the supply of nature's produce? In the first instance they could not stabilise the price of food, and therefore they could not possibly stabilise the price of other products. This was his opinion as an amateur, and it seemed to him that the only thing they could stabilise was the relations between employer and employed. They could then talk to each other, and in so meeting adjust things.

With regard to the production of any commodity, they had got to realise they could not stabilise the raw material. It was always a question of supply and demand. He knew of nothing that would so easily bring about stability in industry as stability of conditions. This was the only thing, to his mind, which could regulate or act as a stabiliser. If an employer knew he had a fixed sliding scale to work upon he could go ahead and make estimates, but if he did not know he could not make estimates, and just as a practical example, he would like to tell the meeting how a few weeks ago his firm lost an order worth £150,000 from a Sheffield firm because that firm only had a certain amount of money available, and could not hope to get credit from the bank if it exceeded its expenditure. It could only get a fixed and firm tender from a German firm, as, under present conditions, no English firm could give a firm tender as regarded price and delivery. As a result, no English firm obtained the order. It had gone abroad. He did not blame the Sheffield firm. As employer and employed, they had got to realise this thing was happening, and they had got to find a means to overcome it.

Various phrases had been used—and it was difficult to keep them apart from the subject—relative to higher wages, unemployment, profits, bonuses, &c. He was aware that all these things were interdependent, and that they could not discuss one without having the whole picture presented. All people engaged in industry had got to realise they must produce cheaply, and jointly concentrate on how they could do it. It was essential, and he was firmly of the opinion that the more articles they could bring within the reach of the largest number of buyers the less likely were they to suffer from unemployment. If a motor car cost £2,000—to give one example—the people who could afford to give £2,000 for it were quickly supplied, but if that motor car were to cost only £400, then the demand for motor cars would be so great that active employment in that trade would proceed for a goodly number of years. Under the latter conditions, each single worker might not earn more or less, but so many more workers at the same wages would find employment which would probably prove continuous. The same thing applied to all other industries.

If employment continued there were always men at work economising and introducing new inventions which made new industries spring up and create further employment. It was only by applying skill, and producing in such quantities as he had indicated, that prosperity could be obtained. They not only wanted to produce cheaply for the purpose of having a large clientèle, but equally in order to purchase cheaper. It was not commonly understood that the price at which they produced at home was the price at which they could buy abroad. The foreigner did not base his selling price to the English people on his cost of production, but he quoted just a little cheaper than the price ruling in the home market fixed by English producers. The foreigner would not buy off the British firms when he could get the goods cheaper in other markets. That was another reason why they should produce cheaply, and it was essential if this country was ever to get out of its present difficult financial and economic position. It was a matter which was so important that employers, as well as trade unionists, should concentrate their attention upon it. There was one other example which he would like to put before them, and it was in relation to the business in which he was concerned.

They started, twelve months ago, to place a contract for a large telephone works in this country in order to enable them to cope with the big demand that would be world-wide. They placed the contract with a firm of most energetic builders, who promised to finish it in six months, but it was still unfinished. What did it mean? The methods of the building trade might have the effect of keeping a few men a little longer on the job, but, as a consequence, they were keeping thousands of men out of work. Had those new buildings been finished his firm would have been employing 2,500 skilled workers in them, and they would have been securing orders which would have speedily enabled them to employ double that number. In Coventry to-day, they would have been employing that number had those works been ready. While the building trade was thus impeding the development of that work, that number of men in Coventry was being kept idle. The worst feature of the whole matter was that while they in England were standing still, their foreign competitors, Germany and America, were forging ahead.

In six months' time they might find that, as a result of the delay they would have lost the command of the greater percentage of that vast field of foreign trade. Once other standards were fixed in the world, it would be difficult for England to even get in. He only wished to make these few observations in the hope of helping all to realise that this question of stability was a common problem. They no doubt had not all made up their minds as to what was the right thing for the future. The war had brought them into a new world, and there was much for them to learn, so why should not they work, study the position, and learn together, and unitedly do the best they could for each and every human being engaged in industry on which their individual and national prosperity depended?

A GLASGOW TURBO-ALTERNATOR BREAKDOWN.

The following interesting communication has been received from the Metropolitan-Vickers Electrical Co., Ltd.:—

On the morning of December 8th, one of the new 15,000-kW turbo-alternators at the Dalmarnock electricity station, Glasgow, broke down after having been in commercial operation for about 2½ months. The insulation on the windings at one end of the machine took fire, and as the turbine could not be stopped for some twenty minutes, the whole of the insulation on that end of the machine was destroyed. No evidence could be found at the time to indicate the cause of the breakdown; the machine was very heavily insulated, and every precaution had been taken with regard to winding and testing.

As another generator was almost ready for service, it was substituted for the first machine, and although the breakdown occurred on a Wednesday morning, the new machine was put in position, dried out, and put on load the following Wednesday.

After operating on commercial load for about a week, sparks were seen to be issuing from the top of the stator frame, and the machine was shut down. The windings were found to be in perfect condition, and the machine was run up again with its field excited, but sparks were again noticed, and further examination showed that one of the insulated bolts through the core had broken down near the endplate. These bolts pass through the core in an axial direction, and serve to hold the end plates tightly against the laminations. The bolt was removed, and it was found that it had vibrated violently and the insulation had broken down near the centre of the core as well as near one end. The windings were found to be in perfect condition, but an inspection of the other bolts which had not given trouble showed that vibration of a more or less serious nature had occurred on several of them.

A series of tests and investigations were at once undertaken, and it was found that, for the particular length and diameter of bolt used, a relatively slight tension was sufficient to bring the frequency of the bolts to such a value as to synchronise with the frequency of vibration of the whole set, corresponding to a speed of 1,500 r.p.m. A further and more careful inspection of the first machine which had broken down showed that its failure was due to similar trouble, as it was found that one of the bolts had broken down to the core, and molten metal had come into contact with the insulation at one end of the machine, thus setting it on fire.

A third generator was practically ready for running at the time the first breakdown occurred, and it was decided to remove the steel core bolts and replace them with copper bolts of smaller diameter, which would carry heavier insulation. These bolts are stressed to such a low value as to leave their natural frequency very far below the running frequency of the machine. A considerable amount of work was required in order to replace the bolts, but this was done in an exceptionally short time, and before the end of the month the work had been completed, and the machine was under load. Since that time it has carried peak loads up to 21,000 kW. The two machines which broke down are being rewound, and will shortly be in commission.

The use of core bolts has been standard practice on the part of many manufacturers in this country, America, and on the Continent; machines in which this construction has been used have been in operation for 15 years, and the West-

inghouse Co. of America has a very large number of machines in operation in which the same construction is used. This is the first case on record where trouble has resulted due to the use of the core bolts, and it is very remarkable that it should have occurred on two machines in such rapid succession, though the fact that they are duplicates and built by the same workmen may explain the fact.

The trouble was due to the fact that a peculiar combination of conditions resulted in the bolt having a frequency equal to that of the machine, and vibration once having been set up, the insulation on the bolts was more or less rapidly disintegrated. While the Metropolitan-Vickers Co. assumes full responsibility for the trouble which has occurred, the following points might be emphasised :—

(1) The insulation on the windings of the machines has been in no way responsible for the breakdowns; (2) the voltage between the bolts and the core was approximately 100, and while the damage was due finally to the breakdown of the insulation on the bolt, the cause of the breakdown was purely mechanical; (3) the construction which was responsible for the trouble is not a new or experimental one, the breakdowns being due to a particular combination of conditions, the existence of which could not reasonably have been anticipated.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1

4,181. "Electric arc welding." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 4th.
4,193. "Protective systems for turbo-electric, &c., generating sets." J. A. Kuyser and Metropolitan-Vickers Electrical Co., Ltd. February 4th.
4,194. "Electrically heated cooking ranges." Metropolitan-Vickers Electrical Co., Ltd. February 4th. (United States, March 1st, 1920.)
4,195. "Electrically heated cooking ranges." Metropolitan-Vickers Electrical Co., Ltd. February 4th. (United States, March 1st, 1920.)
4,205. "Electric lamps for theatrical purposes." F. C. Davies. February 4th.
4,218. "Discharging devices for electric furnaces." E. C. Beck-Friis and C. I. Thorssell. February 4th.
4,223. "Incandescent electric lamps." W .M. Rogerson and Stella Lamp Co., Ltd. February 4th.
4,226. "Glass filters, &c., for gas-filled electric lamps." E. L. Friedmann and Co. February 4th. (Germany, February 20th, 1920.)
4,228. "High-frequency electrical apparatus." R. Heather and Mitchell's Electrical & Wireless, Ltd. February 4th.
4,233. "Sparking plugs." G. T. Wilson. February 5th.
4,238. "Electric cables." E. S. Seymour. February 5th.
4,239. "Electric welding machines." R. F. Woodburn. February 5th.
4,247. "Electric furnaces." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. February 5th.
4,249 "Electrical measuring instruments." R. F. Hamilton & Co., Ltd., F. S. J. Pile, and G. E. M. Stone. February 5th.
4,253. "Electric switches." G. Winter and R. Winter. February 5th.
4,261. "Electric signal for road transport, &c." E. G. Beynon and A. A. Evans. February 5th.
4,267. "Means for regulating current output of dynamo-electric generators." J. M. Torrance and J. W. Torrance. February 5th.
4,279. "Annunciators for hotels, &c." T. M. Down. February 5th.
4,281. "Electric advertising machine." G. Wallace. February 5th.
4,285. "Dynamo-electric machines." J. W. Burleigh. February 5th.
4,292. "Dynamo-electric machines." A. H. Midgley and C. A. Vandervell and Co., Ltd. February 5th.
4,300. Means for supplying current to valve amplifiers." P. P. Eckersley, J. M. Furnival, J. Stewart, and H. R. C. van de Velde. February 5th.
4,301. "Telephones." T. M. Inman and Relay Automatic Telephone Co., Ltd. February 5th.
4,308. "Burglar alarm." F. Sefcik. February 7th.
4,320. "Dimming device for electric lamps for motor vehicles, &c." Brolt, Ltd., and W. Holt. February 7th.
4,321. "Electric horns." Brolt, Ltd., and W. Holt. February 7th.
4,325. "Trolley-pole attachments for electric trams, &c." P. Priestly. February 7th.
4,329. "Electric indicator or movable sign." E. W. Jeffs and H. E. Lancaster. February 7th.
4,345. "Combination electric iron and curling-tongs heater." E. H. Kinnaird. February 7th.
4,359. "Electrically-heated hair waving or curling apparatus." S. Hargreaves. February 7th.
4,361. "Electric switches." S. J. Thompson. February 7th.
4,377. "Manufacture of carbon electrodes." I. Szarvasy. February 7th. (Hungary, November 29th, 1917.)
4,381. "Wireless signalling." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 7th.
4,382. "Electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 7th.
4,390. "Electrically-heated kettles, &c." F. Robinson. February 7th.
4,392. "Sparking plugs." P. A. Pollard. February 7th.
4,394. "Apparatus for collecting electric current for electrically-propelled vehicles by means of carbon brushes." Soc. Anon. le Carbone. February 7th. (France, October 15th, 1920.)
4,408. "Mercury vapour jet pumps with light arc." Siemens & Halske Akt.-Ges. February 7th. (Germany, April 24th, 1920.)
4,410. "Electric rotary converter with variable tension." R. de Bruyn. February 7th. (Belgium, February 5th, 1920.)
4,413. "Stripping insulation and armour from cables, &c." C. W. Bailey and A. Weir. February 7th.
4,420. "Platinum anodes." Deutsche Gold and Silber-Scheideanstalt vorm Rössler and O. Liebknecht. February 7th.
4,432. "Electric furnaces for non-ferrous metals." D. F. Campbell, W. S. Gifford, and H. S. Waite. February 7th.
4,446. "Pulleys for trolley-poles of electric tramcars, &c." G. A. Bishop and R. A. Chadwick. February 8th.
4,454. "Electric toasters, &c." Credenda Conduits Co., Ltd., and F. F. D. Davidson. February 8th.
4,459. "Automatic, &c., telephone systems." W. Aitken. February 8th.
4,474/5. "Locking devices for electric incandescent lamps." C. Dunglinson and H. Francis. February 8th.
4,482. "Electric cooking devices." L. S. Dalgleish, Electrical Utilities, Ltd., N. Prentice, and E. Schattner. February 8th.
4,491. "Electric safety lock for railway coaches, &c." T. Pickersgill. February 8th.
4,495. "Telephone repeater monitoring system." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 8th.
4,506. "Electric lighting apparatus." A. Gladstone. February 8th.
4,513. "Signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. February 8th.
4,516. "Rotors for electric generators." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd., and S. Neville. February 8th.
4,536. "Wireless telephone transmitters." Ges. Für Drahtlose Telegraphie. February 8th. (Germany, February 9th, 1920.)
4,538. "Switches for electric circuits." A. Gerhold. February 8th.
4,588. "Electric cable junction boxes." F. H. Morris, T. Taylor, and S. D. White. February 9th.
4,617. "Electric lamp discharge devices." British Thomson-Houston Co. Ltd. (General Electric Co.) and General Electric Co. February 9th.
4,619. "Electric circuit interrupters." Metropolitan-Vickers Electrical Co., Ltd. February 9th. (United States, April 23rd, 1920.
4,650. "Electric light adaptors for acetylene lamps." A. H. Lindley-Jones. February 9th.
4,663. "Heavy current transmitter for telephony." P. J. Walsh. February 9th.
4,664. "Wireless signalling in mines." Ges. für Drahtlose Telegraphie. February 9th. (Germany, February 9th, 1920.)
4,667. "Automatic cut-out for receiving gear in wireless telegraphy and telephony." H. Morris-Airey, C. R. Evershed, and L. G. Preston. February 9th.
4,684. "Steering indicating means for railless trams, &c." R. H. Wilkinson. February 10th.
4,695. "Apparatus for synchronising electrically the application of indications to a plurality of charts, &c., in different localities." B. Holliday. February 10th.
4,698. "Electric conductors for telegraphy, telephony, &c." W. E. Hitch. February 10th.
4,700. "Radio receiving systems, signalling systems, &c." N. Lea, Radio Communication Co., Ltd., and J. Scott-Taggart. February 10th.
4,720. "Internal galvanisation of insulators." Soc. Materiale Elettro Trazione. February 10th. (Italy, February 12th, 1920.)
4,723. "Magneto-electric machines for engine ignition." G. L. Neighbour. February 10th.
4,737. "Telephones." G. B. Riley. February 10th.
4,743. "Electric heaters for liquids." W. Weekes. February 10th.
4,745. "Dynamo-electric machines." J. H. Cochrane and J. Gordon-Hall. February 10th.
4,747. "Travelling carriage with automatic steering device for passing through junctions on a single-joint overhead runway track." J. Hill & Sons. February 10th.
4,749. "Magnetic fields of electric machines." J. W. Howard. February 10th.
4,750. "Electric switches." H. D. Pyne. February 10th.
4,753. "Electric switchgear." H. W. Clothier, F. N. Linstow, and Reyrolle & Co., Ltd. February 10th.
4,754/5. "Electric terminals." G. W. Bayley and F. N. Linstow. February 10th.
4,761. "Arrangements for recovery of energy in electric railway systems employing series-connected direct-current motors." E. Santuari. February 11th. (Germany, March 12th, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

12,158. "Electric gasfilled glow discharge lamps." Lederer. May 19th, 1913.
13,759. "Electric lamps with luminous discharge." British Thomson-Houston Co. (General Electric Co.). June 6th, 1914.
24,343. "Telephone systems." Automatic Telephone Manufacturing Co. and Savin (partly communicated by Automatic Electric Co.). December 19th, 1914.

1917.

3,719. "Electro-magnetic clutch." Vulcan Maschinenfabriks Akt.-Ges. October 22nd, 1913. (104,876.)
3,720. "Electro-magnetic friction clutch." Vulkan Maschinenfabriks Akt.-Ges. October 22nd, 1913. (104,877.)

1918.

7,729. "Fixing of electric insulators." P. J. Pairard. May 8th, 1918. (157,470.)

1919.

3,702. "Means for controlling the flow of electrons in electric-discharge devices." Marconi's Wireless Telegraph Co., Ltd. (E. Berry). February 14th, 1919. (157,477.)
7,464. "Means for controlling searchlights from a distant station." P. W. Willans. March 25th, 1919. (157,481.)
20,260. "Intercommunication telephone systems." W. P. Thompson (F. Humes). August 18th, 1919. (157,496.)
20,513. "Electrical indicators for railways and the like." J. Gardner. August 21st, 1919. (Cognate application 3,647, 1920.). (157,498.)
20,676. "Electric fuses." B. C. Candee, F. Moeser, and W. N. Pierce. August 22nd, 1919. (157,499.)
23,613. "Electrical systems of power transmission." British Thomson-Houston Co., Ltd. (General Electric Co.). September 25th, 1919. (157,508.)
23,949. "Electrode for use in depositing molten metal and process or method of making same." W. H. Boorne. September 30th, 1919. (157,509.)
24,470. "Electric traction systems having one or more conductor rails." K. Pattison. October 7th, 1919. (157,516.)
24,732. "Electric transformers and other stationary electric induction apparatus. British Thomson-Houston Co., Ltd. (General Electric Co.). October 9th, 1919. (157,521.)
25,182. "Electrodes, welding rods, and soldering sticks." E. H. Jones and Alloy Welding Processes, Ltd. October 14th, 1919. (157,534.)
25,230. "Magneto hand lamps." A. H. Railing and A. E. Angold. October 15th, 1919. (157,536.)
25,277. "Means for connecting two axially-arranged poles." E. Schultz. February 6th, 1918. (133,938.)
25,661. "Signalling arrangements, applicable to telegraph, telephone, and like purposes." Automatic Telephone Manufacturing Co., Ltd., and H. H. Harrison. October 20th, 1919. (157,556.)
25,826. "Air cooling apparatus particularly applicable to the cooling of electrical machines." K. Baumann and Metropolitan-Vickers Electrical Co. Ltd. October 21st, 1919. (157,562.)
26,980. "Incandescent electric lights." M. C. Caughrean. November 3rd, 1919. (157,585.)
27,223. "Radiating or cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. November 5th, 1919. (157,591.)
27,346. "'Ironclad' electrical switches." Midland Electric Manufacturing Co., Ltd., and W. L. Barber. November 6th, 1919. (157,595.)
28,301. "Receivers for wireless telegraphy." C. T. Hughes and L. B. Turner. November 14th, 1919. (157,607.)
29,078. "Device for use in disinfecting telephone instruments." R. Cooper. November 22nd, 1919. (157,614.)
30,922. "Protective devices for alternating electric current systems." J. B. Palmer and Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (157,626.)

1920.

25,219. "Signalling apparatus for road vehicles and aeroplanes." H. Fryman. September 17th, 1919. (Divided application on 151,306.) (157,697.)